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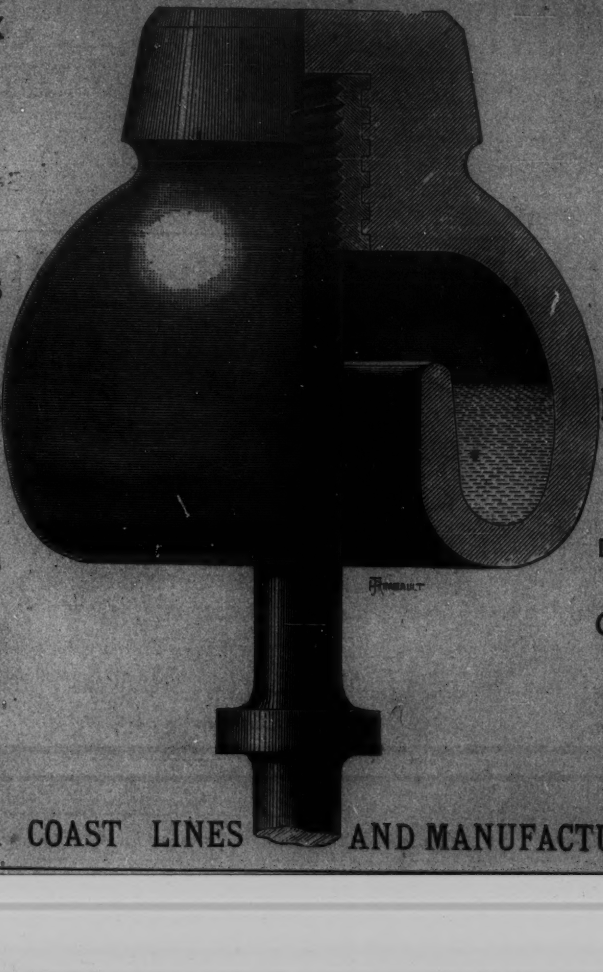

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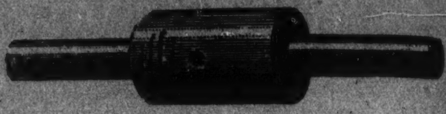

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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVI.—NO. 379.

UNDERGROUND WIRES.

THE system of underground wires recently laid down on the Continent is, from certain points of view, probably as satisfactory a one as could be adopted. There is little reason to suppose that it will prove otherwise than durable. In cases where the number of conductors required is small and is likely to continue small, a cable of the submarine type, as is employed in the continental system referred to, would perhaps be as economical an arrangement, consistent with durability, as can be desired. Such a system is not, however, capable of expansion; that is to say, if the number of the conductors requires an increase at any time, it necessitates re-opening the trenches and laying down a new cable. The pipe system, as adopted by the Postal Telegraph Department, is free from this disadvantage, inasmuch as it allows of a limited number of wires being placed in the first instance, which number can at any time be increased up to the full capacity of the pipe without the necessity of opening the trench, except at intervals of 200 yards. With gutta-percha of good quality there is no reason to suppose that wires buried in this manner should not last for a lengthened period. The Brooks oil system, which we have described in previous numbers of the REVIEW, unquestionably possesses the important element of durability in the very highest degree. It is also a cheap method, and the only objectionable feature is the necessity of having reservoirs at intervals along the route; in many cases, however, this objection is not a great one. The agitation which seems to be perpetually taking place in the United States with reference to the continued use of aerial wires in towns has apparently resulted in the starting of numerous companies, which have for their object the working of various patents for placing underground wires. The question of underground work in towns is distinct from that of general cross country communication, inasmuch as it is not telegraphy (and telephony to a limited extent) that alone requires to be considered. Any complete system must include lighting and the transmission of power by electricity, and this involves some effectual means of avoiding inductive interference with the telephone circuits. The exhibits at the International Electrical Exhibition held last year at the Franklin Institute, Philadelphia, show that the Americans are in earnest in the matter, and something practical may emerge from the numerous designs which have been put forward. In most of the latter it is suggested that the conduits should be kept dry by artificial means, and this we think is a right step. In any case we think it would be necessary to have the wires insulated throughout their length, as the employment of bare wires separated at intervals by porcelain or other supports, as has often been proposed, would not, we think, afford a sufficient margin of safety. We intend to refer shortly to the reports of the Examiners on the Underground Conduits as exhibited at the Electrical Exhibition.

ELECTRIC LIGHTING IN THE CITY OF TEMESVAR.*

WE will first mention in correction of our former report that the Temesvar gas works still supply gas, though only to private persons, the public streets being lighted by electricity. We will now give a description of the installation, so far as it possesses any technical interest, and communicate certain relevant documents.

The premises of the central station are situate in the "Fabrik" suburb, in the so-called Roper's Meadow, by the River Bega. They include a dynamo house, a machine and boiler house, and certain offices.

There are two Lancashire boilers, constructed by E. Heaton, Star Boiler Works, Manchester. Each boiler has two fire tubes, connected by cross tubes on the Galloway system, for the purpose of presenting a greater heating surface, and effecting a better circulation of the water. Each boiler has four safety valves weighted at the normal steam pressure.

The driving engine is a compound steam engine of 300 horse-power, with expansion, condensation, Corliss gear, and two regulators.

The engine communicates to the counter-shafting a speed of 300 revolutions per minute. This again gives a speed of 700 revolutions per minute to the dynamos by means of plain leather driving bands.

As regards dynamos, there are five large Brush machines (pattern 8), four of which carry on the ordinary work, while the fifth is kept as a reserve. Each machine supplies its own special circuit.

The Brush machines are of the same kind as the ordinary arc light machines. A group arrangement was therefore necessary. The electrical constants of the Lane-Fox lamps used are, for a normal strength of light 55 volts, 44 ohms and 1·25 ampères. As the strength of the current of the Brush machine = 10 ampères, eight lamps must be arranged in parallel groups, which are then introduced serially.

As there are 731 glow lights to be supplied, 184 fall to each circuit. The number of the parallel groups introduced successively is, therefore, in each 23.

This arrangement has, as is well known, the advantage of a small section of copper conductors. The main conductors, in fact, consist only of copper wires, 5 millimetres in thickness, insulated to a thickness of 2 millimetres.

On the other hand, this arrangement has the disadvantage that the lamps cannot be extinguished at pleasure singly, as in the ordinary parallel arrangement. This could only be effected by introducing in place of the lamp to be extinguished an equal resistance of 44 ohms. It must, however, be remembered that the installation has hitherto been applied only to the purpose of street lighting, where the lamps have always to burn for an equal time, and to be extinguished simultaneously. For this special purpose the arrangement adopted is perfectly justifiable. It is even superior to a gas system, or to an electric illumination arranged on the ordinary principle, in so far that all the street lamps can be lighted and extinguished at the same time and from one point. The advantages of this feature are manifest. The arrangement is merely questionable in so far as the high working E.M.F.

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* *Centralblatt für Elektrotechnik.*

requires a very good insulation; 23 parallel series at 55 volts give an E.M.F. at the extremities of the machine, which, if we take the resistance of the conductors into account, may be estimated at 1,400 volts. If the machine is well insulated the greatest differences of potential between the conductors and the earth amount to 700 volts. If all the arrangements for insulation are properly carried out there is no reason for serious apprehension, and probably the Temesvar installation will become the subject of interesting studies.

From the arrangement as above described it is clear that an especial apparatus is needed to protect the installation from the disturbance which might result from the burning out of a single lamp. This purpose is mainly fulfilled by the so-called automaton, which at once introduces a fresh lamp as a substitute for an old one. This apparatus is applied in the cap of each street lamp. Fig. 1. The lantern contains two lamps inclined towards each other at an angle of 60°, and protected above by a conical reflector, and below by a glass case.

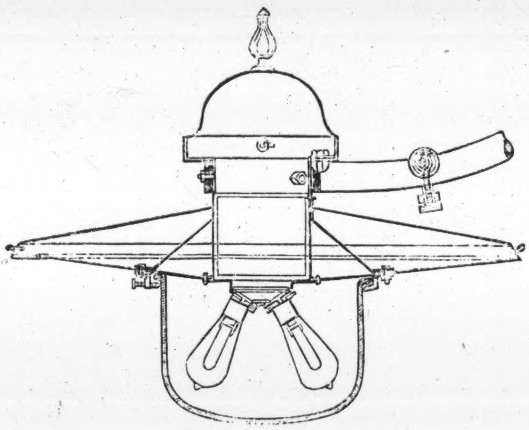


FIG. 1

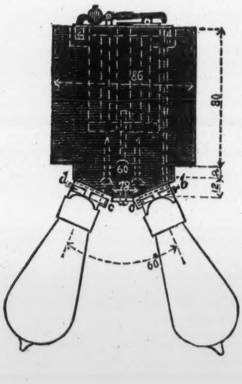


FIG. 2.

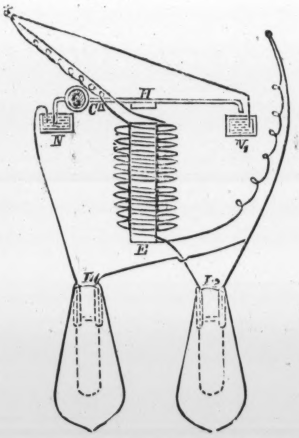


FIG. 3.

Fig. 2 shows the dimensions of the automaton, and fig. 3 its introduction. E is an electro-magnet with a double wrapping; the folds of the one wire (thick) are wrapped in the opposite direction to those of the other (thin) wire. The current enters at the + clamp, passes through the few coils of thick wire and the lamp, L, to the − clamp. The keeper, H, is movable at C, and is drawn somewhat backwards by the counterpoise, G, so that its long arm does not dip into the cup of mercury, N_1, whilst the other arm of the lever dips in at N. The fine wire wrapping of the magnet is so adjusted that the product of its number of coils is equal and opposite to the product of the strength of the current 1·25 ampère and the number of coils of the thick wire. The effects of both coils upon the core of the magnet annul each other, and the latter is acted upon solely by the weight, G, which keeps it in the attitude shown in the figure.

If the carbon filament of the lamp, L_2, breaks, the magnet covered with thick wire no longer receives a current; the magnetisation of the iron core by the fine wire coiling, hitherto kept in check, comes now into play, and is rather increased by the slightly augmented difference of tension. Consequently H is attracted, and the end of the lever dips into N_1, thus introducing the reserve lamp, L_1. In the meantime the lamp, L_2, can be replaced by a fresh one.

Further, the several groups are also protected against any over-straining by special group automatons, so as to meet the exceptional case that several lamps might break in one evening. The introduction of the latter apparatus is shown in fig. 4. The arrangement is the same as in the single lamp automata, but without the thick wire. If, in consequence of an increased group resistance due to the failure of a number of lamps there ensues a considerable difference of tension of the two main conductors of the groups the magnet, E, H, acts, the arm of the lever dips in at N_1, and a suitably selected resistance is introduced parallel with the lamps, so great that the lamps may continue glowing, although with diminished lustre. The inspector can detect the lamps which have occasioned the disturbance and restore the *status quo*. This apparatus will probably rarely come into requisition.

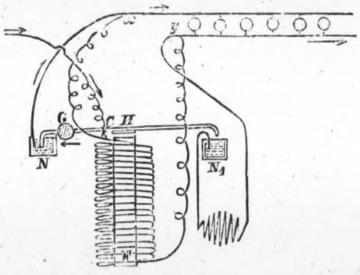


FIG. 4.

We turn now to discuss the experience hitherto reaped at Temesvar. The installation has only been in action since November 12th last, and it would therefore be premature to pronounce a definite opinion. Certain points, however, may be taken into consideration. In the night from November 23rd to 24th the lighting was interrupted as in consequence of the low state of the Bega, which supplies the boilers, the pumps would not act. Hence the pump well has had to be made two yards deeper. This occurrence shows plainly that a reserve of motive power is no less necessary than an electrical reserve.

As regards the effect of the lighting, it may be well to consider the opinion of a specialist, M. Lázár, manager of the Szegedin Gas Works. He writes in the *Gas Journal*:—

"I must still mention a third defect, which seems to me not unimportant, though it has hitherto been overlooked. I have already mentioned that the impression of streets lighted up with electric lamps corresponds with that of gas lamps, save in one point. The perspective of a long street, showing luminous points in regular succession is pleasing, agreeable to the eye, and satisfies the æsthetic sentiment. But if we look a little more closely we observe, to the annoyance of our eyes, that the light radiating from the glow lamps is thrown upon the ground by the reflector in the form of a cone, the base of which is a sharply-defined luminous circle. Within this circle there is a clear light, but without it deep darkness. Hence there is an alternation of bright circles and very long, dark intervals. Such street lighting is inadequate and hurtful to the eye, on account of the abrupt transit from light to darkness. A main condition of public lighting is the most uniform possible distribution of the light over the whole extent, so that between two lamps there may not appear a single point of total darkness."

We quote this opinion, but we must confess that according to the shape of the reflectors, as shown in fig. 1, we fail to see how the effect complained of is produced. The reflector distributes the light not in a small circle but even, horizontally, and consequently to an endless distance. Perhaps M. Lázár will have the kindness to explain this contradiction.

Disturbances in the telephonic system of Temesvar have been perceived, for which we must refer to subjoined documents.

The financial phase of the matter seems to us to be involved in doubt. The city pays yearly 29,000 florins, or per evening 79·45 florins. This seems to us a very low estimate for eight hours work, employing a 300 horse-power steam engine, even if 120 horse-power only were actually used. In this respect we must wait for the lessons of the future.

We subjoin the following documents:—

I. *Opinion on the Installation for the electric light in the City of Temesvar.*

The opinion which the municipality has obtained from Prof. Joseph Sztoczek, and from Joseph Kareis, Commissioner of Telegraphs, and which has been published in the *Temesvar Zeitung* of December 2nd, is literally as follows:—

1. Are the experts, after having tested the entire installation for lighting, of opinion that this installation is perfectly suitable, and can they advise the city to require any alterations as regards the trustworthiness of the arrangements?

The entire installation, consisting of the engine, the dynamos, the lamps with their automata and the conductors, must be considered severally.

As for the machinery, it must be assumed that the expected second steam engine will be placed along with the present one as early as practicable.

As the application of the Brush machine, with its high tension currents, must be regarded under existing circumstances as an accomplished fact, and as the entire installation must stand or fall with this machine, and a fundamental change in this respect cannot be recommended, and as this machine—setting on one side its real danger for the uninitiated—gives satisfaction by its substantial execution and its good working, there is no adequate ground for raising further objections to this part of the installation.

The localities for the machinery and for measurement are well arranged; everything is open to view and well contrived; the connections are convenient, and the measuring instruments, as they now exist, give a view of the work performed and of its various factors.

The lamps have evidently not yet all an equal resistance. But this defect in certain lamps is not very frequent if the entire number is taken into consideration. Their appearance is pleasing, and the mounting very simple, but upon the whole very suitable.

The lamp automata were found on testing to be suitable for use. It cannot, however, be denied that they were tested under favourable circumstances. Hence there is no proof that these instruments will act under all conditions and after prolonged use since the oxidation of the hinges and supports of the contact levers may interfere with the mobility of the latter.

The mercury must be always supplied in sufficiency. The inspection subsequently recommended must extend to all these points.

As for the conductors, it must be pronounced that this is a part of the arrangement which the experts regard as not fully equal to the demands which may be made upon such an installation. In addition to the æsthetic, physical and mechanical shortcomings which in part already exist, and in part will make themselves felt in the course of time, the conductors may give rise to disputes between the municipal authorities and the electric light company.

The municipality has sought to determine by means of certain penalties that the company devote the best possible attention to this installation. Still the case of an arbitrary interpretation of the terms of the agreement is not absolutely excluded.

It is possible that the company, in case of prolonged mist, rain—in short, damp weather—may wish to view this as an elementary occurrence, for the consequences of which they are not responsible whilst the inperfect insulation of the conductors are the cause of the disturbance.

The so-called bands and soldering places are the most formidable enemies of the continuity of overhead conductors. Both these and the attachments of the wires to the insulators leave much to be desired, as appears from the measurements undertaken by the Commission. As the existing circumstances exclude an early conversion of the overhead into an underground system, it should be required of the company that they, to their best ability, should at once, in their own interest, seek out and correct the weak points of the conductors; that they should then ascertain the degree of insulation of the conductors in the four circuits and in different states of the weather. A knowledge of these circumstances should then be acquired by regular—if possible, daily—measurements, in order that such faults may not be shown merely by the degree of the illumination and other faults, such as those of the lamps, &c., which may pass unnoticed.

It must not be forgotten that overhead conductors, under proper inspection, have the advantage that any faults occurring can be readily detected and remedied.

The group automata will not probably come very often into action. So much the more do they demand a strict inspection. In addition to the faults mentioned above in reference to the single lamp automata, there is the further defect that they show the magnetism contained in them. This causes the lever which had fallen down and has been raised up again by hand, to re-descend, when the entire group of lamps glows dimly. A further circumstance is disadvantageous for the light, *i.e.*, if the lamps which have given cause to the activity of the automaton are at some distance from it, the reaction of the group requires some time; here, also, moisture must be carefully guarded against.

All the defects pointed out should simply enforce the necessity of arranging a close and careful inspection of the entire installation.

2. Is the system of lighting introduced fully on a level with the present position of electrotechnics?

The entire field of electrotechnics is in a state of transition; the limits of this science are being daily extended by observation and experiment. Each inventor and projector recommends his system as the most trustworthy, but it soon appears that his system is neither incapable of increase nor of modification. It may be conscientiously said of the Temesvar installation that it is a bold exception to the most usual systems of the day and to rule. As much, however, may be said of every important innovation, and future experience must show the value of the installation in its whole extent.

3. Is the overhead conductor at all permissible from the point of view of security for the lives and property of the inhabitants, and is it possible to meet effectually by suitable police regulations the degree of danger which belongs to overhead conductors? Do not the experts consider it absolutely necessary that in the agreement about to be concluded the city should keep its hands free as regards the abolition of overhead conductors on the basis of experiments about to be made with atmospheric electricity, and especially in the case of repeated disturbances and dangers?

It is beyond all doubt that in addition to the defects already mentioned, an overhead conductor gives room for dangers. By accidental or intentional contact with any uncovered portions of the conductor, life may be imperilled. There is also a risk of conflagration in case of a sudden interruption of the conductor if the spark strikes very combustible bodies. It is also possible that wires may become incandescent, when there is danger of fire even with moderately combustible substances. Such incandescence will happen wherever so-called short circuits are formed and where a relatively powerful current has to traverse their wires. It must, however, be remarked that these dangers can be rendered extremely rare by due management; and both in this and other installations they can be effectually combatted by proper technical municipal arrangements and by the necessary inspection.

As to the danger of lightning, we cannot deny its possibility, as the conductors, which include large masses of metal, may be involved in violent thunderstorms accompanied by rain. We are, however, in want of a trustworthy standard in order to estimate the frequency and the degree of danger in such cases where overhead conductors are insulated from the earth and from each other. In view of all the above circumstances, it is advisable that the municipality should reserve its freedom of action for all steps relating to the overhead conductors.

4. Can continuous action be expected from the system of electric lighting which has been introduced, or are disturbances to be expected in the lighting of the city of such a nature that the introduction of the electric light on the present system appears hazardous?

If the above-mentioned precautions are adopted, if a strict inspection is maintained, and if penalties incurred are enforced without hesitation, it may be expected that the regularity of the light will be ensured as far as possible. The novelty of the arrangement of the glow lamps and the use of the self-acting switches do not allow us to speak with full confidence as to the perfectly undisturbed continuance of the light. The interruption, however, cannot be of long duration. The precautions indicated give efficient means for the prevention of such incidents.

5. What illuminating power have the lamps of the existing normal lighting arrangement given off up to 12.30 in the night, and what afterwards, and what is the conclusion of the experts as to the colour of the light at the agreed scale of 16 candles, *i.e.*, is the light at the strength of 16 candles of such a composition that it may at least be an efficient substitute for gas as far as a pleasant and suitable tone of colour is concerned?

In the photometric determination undertaken the mean power of the glow lamps, as they burn up to midnight, was found = 18½ normal candles; after midnight the luminous power was 10 candles. On examining the glow lamps fixed at a standard of 16 candles, their colour was found to be light yellow, bordering on white; the 8-candle glow lamps were yellow, verging to red. In this respect, and in that of steadiness and equability, no more pleasant effect could be wished for. Gas light is decidedly inferior to this electric light.

6. Have the photometric experiments shown an equal luminous power for the lamps, and is an equal light to be expected for the future?

The question of equal illumination, as far as it concerns the single lamps, and as far as it depends on the movement of the engine and the dynamos, has been satisfactorily solved by this installation. As to the equality of the luminous power of the different lamps, there is at present no considerable difference perceptible. It is to be expected that on prolonged experience a gradual improvement may be looked for.

7. Do the experts consider the disturbances in the telephone as a direct consequence of the introduction of the electric light? Are these irregularities of such a nature that telephonic intercourse will become impossible, and what means would the experts propose to prevent this misfortune?

The irregularities in the telephone are certainly an effect of the dynamo currents. It is, however, possible that other causes may co-operate, though in a less degree. By an accurate graphic representation of the conducting systems, both of the telephone and of the electric light, we may obtain grounds for forming an opinion concerning the intensity of the action of the latter upon the former, and thus obtain indications in what direction a remedy may be sought for. Amongst the means suggested there is room for choice, perhaps, according to circumstances. Induction bobbins, resistances, condensers, increased battery power, microphones, and, above all, a change in the direction of the conductors must be tried. As the Royal Hungarian Telegraph Department intends to examine the question of telephonic irregularities as coming within its scope, the resolutions of this authority cannot be anticipated by any direct proposal.

8. General Opinion. The entire installation has worked satisfactorily from the outset to the present day, thus giving good hopes of its trustworthiness. The weaknesses of the system have not been concealed, since the experts have been actuated by the principle of telling the whole truth, as attainable within the present bounds of knowledge. It cannot be denied that the above-mentioned defects are counterpoised by great advantages. This system, before all things, offers the possibility of supplying distant quarters of the city with a pleasant and relatively cheap light from a central station. It is to be remembered, however, that in no distant future we may expect a decision of the Government concerning electro-technical installations, which may touch and modify many points which have been here discussed, and which will be embodied in the agreement to be concluded between the municipality and the company.

If within the course of a year frequent irregularities and accidents of a serious nature occur from the working of the installation, or if the constructive peculiarities of the installation cannot be brought into harmony with the expected Government measure, this must be an unconditional ground for the avoidance of the agreement.

The experts would gladly welcome the conclusion of a definite agreement of this nature.

Temesvar, *November 27th*, 1884.

Signed :—

Dr. JOSEPH SZTOCZEK,
Professor at the Royal Polytechnicum.

JOSEPH KAREIS,
Imperial and Royal Commissioner of Telegraphs.

II.—*Resolution of the Municipal Committee.*

Concerning the session of the ordinary general meeting of the Municipal Committee of the Royal Free City, Temesvar, December 1st, 1884, the *Temesvar Zeitung*, of December 2nd, writes as follows :—

After the above given report of the experts invited to test the electric light installation had been read over literatim by the deputy Baader, the mayor, Von Török, stated that it would have been necessary for the Local Commission to give a written opinion, though for this there had been, hitherto, no time. The document will be brought forward. Until that takes places the referee of the Local Commission will give, briefly, the opinion of the latter body.

The deputy Baader then began an address in which he defined the point of view of the Local Commission. He began his exposition with an account of the installation for lighting, which was very intelligible, and was heard with great attention. Taking up singly the questions which had been put to the experts, he pointed out the important fact that the company had still 150 horse-power at their disposal to increase the existing number of lamps if the city should wish it. He mentioned, as the principal defect, that there was not a reserve driving engine, which might give rise to serious irregularities. The company, however, admit this as a deficiency and are about to remedy it without loss of time. The danger to life, from contact with the wires, did not seem to the speaker so great but what it might be met by suitable police regulations, as had to be done with machinery of all kinds. He touched at some length upon the strength of the light, concerning which very inaccurate views were entertained by the public. The effect of the light was perfectly satisfactory. The speaker added that it had been declared by the Ministerial Councillor Koller that the Government regarded the enterprise of the city with favourable attention and would do everything on their part to promote it. As to the Local Commission, he continued, it wished at first not to conclude the agreement, but wait until the summer in order to ascertain how the lighting arrangements might be affected by the atmospheric electricity. They had, however, abandoned this view, as the city would, in any case, have its hands free and could at any time introduce a new system of lighting if the present installation did not prove satisfactory.

The deputy Brand next came forward. He explained that the experts had not given a positive opinion, which in the present state of this science was scarcely possible. He held that the city should complete the agreement, but in such a manner that it, as well as the company, could withdraw if necessary. He considered it an honour to Temesvar to have taken the initiative in an affair of such importance. (Applause.)

The next speaker was the Mayor Török. He explained that the city when it resolved on the experiment with the electric light was not merely induced by the desire of introducing an epoch-making novelty, but by the behaviour of the gas company, which left much to be desired. He mentioned the advantages of the electric light, which are essentially that it surpasses gas in intensity, that the suburbs now enjoyed the benefit of being lighted up, and that the number of lamps burning all night had been increased. The introduction of the electric light was therefore desirable in the highest degree, the only question being whether it would act for the future. This is to be hoped, but only practical experience can give a positive answer. Hence it is a duty, whilst introducing the light, to take such precautions as may protect the city and secure its liberty of action. The affair is good, and to be recommended, but not proved, and therefore the agreement must be so drawn up that the city can introduce a different light if needful.

The chief notary, Dr. Tellbiss, then read the agreement, which provides that if there occur in the street lighting such repeated irregularities as to prove the present electric installation, whether from defective management by the company, or from other causes, unsuitable or defective, especially as regards uninterrupted illumination, and that if its discontinuance is officially proved requisite by reason of irregularities, the city will be at liberty to give up the electric lighting of the streets and to declare the present agreement as at an end.

The city possesses the same right if the electric installation—whether from its nature, or from deficient management, or inefficient superintendence—is found dangerous to life and property to such an extent that it cannot be met by municipal regulations.

Elementary occurrences, involving irregularities in the light, or occasioning danger and proving this kind of light to be unsuitable or inadmissible, cannot be pleaded by the company in bar of their responsibility, and will also justify the city authorities in declaring the agreement as at an end.

If the agreement is cancelled for reasons which depend on the negligence or inadequacy of the company and its representatives, or on the want of the necessary machinery, plant and apparatus, the security of 10,000 florins is forfeited to the city. If the discontinuance of the agreement ensues from causes over which the company or its representatives have no control the security is to be refunded, after deducting all actual outlay which the city has incurred by the adoption of the electric light (not including the charges for lighting paid to the company).

If the company does not consider the cessation of the electric light and the annulling of the agreement as justifiable it is at liberty to demand arbitration. There are to be two arbitrators nominated by the city and two by the company within eight days, and an umpire appointed by the Royal Hungarian Ministry.

Thanks were then voted, amidst repeated cheering, to the mayor, Von Török, and to the deputies Brand and Baader.

ELECTRIC LIGHTING CONDUCTORS.

IN several of our American contemporaries the three-wire system of conductors attributed to Edison and Hopkinson has engaged considerable attention and some well-known writers have given their views respecting the economy of the two, three and even four-wire systems. We published, at some length, the principal points of value contained in our exchanges, in the REVIEW for the 10th ult., under the heading of "Edison's three-wire system of distribution." Mr. Paul, one of the writers in question, had apparently, in his calculations, left out of consideration the cost of waste heat in the Edison system and also made a mistake in estimating its amounts, and Prof. Carhart pointed out the oversight. Mr. Paul, in a communication to *Science*, after admitting the errors into which he had fallen, proceeds as follows :—"Prof. Carhart has not, I think, quite reached the most economical result, for the reason that we have the interest on n conductors, but heat developed in *only two* of them ; and, as it seems worth while to develop the complete solution for this interesting system, I further submit the following :—

"Suppose the size of conductors in the two-wire system to be such that the interest on their cost equals that of the heat-energy developed in them ($C^2\,R$, using Prof. Carhart's nomenclature), which, for simplicity, we will take equal to unity. The general expressions for the various constants (in terms of those of the two-wire system), when the same plant of lamps is divided up (with n conductors, each of whose cross-sections is k times that of one of the first) into $n-1$ equally-balanced circuits, with $n-1$ dynamos in series, as in the Edison system figured on p. 477, vol. iv. (the same energy being developed in the lamps as at first), will then be :—

$(n-1)^2 . r =$ the resistance of the lamps.

$\frac{R}{k} =$ the resistance of the two outside conductors.

$\frac{C}{n-1} =$ the current in the same.

$\frac{C\,R}{(n-1)^2 . k} + C\,r = E_{n-1} =$ difference of potential at terminals of each of the $n-1$ dynamos.

$\frac{C^2\,R}{(n-1)^2 . k} =$ heat-energy wasted in two outside conductors.

$\frac{C^2}{(n-1)^2} . (n-1)^2 . r = C^2\,r =$ energy developed in the lamps.

$\frac{n}{2} . k . C^2\,R = \frac{n}{2} . k =$ interest on cost of n conductors.

"The energy consumed in the lamps ($C^2\,r$) is the same as at first, as shown by Prof. Carhart, and, being constant for the plant of lamps, need not be further considered. The total running expense, then, *due to conductors* (including interest on their cost), is

$$\frac{n}{2} . k + \frac{1}{(n-1)^2 . k}$$

in terms of $C^2\,R$. This should be a minimum. Its first differential coefficient with reference to k, placed equal to zero, gives

$$k = \frac{1}{n-1}\sqrt{\frac{2}{n}}$$

as the most economical section. This gives, for the minimum value of the total running expense,

$$\frac{1}{n-1}\sqrt{\frac{n}{2}} + \frac{1}{n-1}\sqrt{\frac{n}{2}} = \frac{1}{n-1}\sqrt{2\,n},$$

the interest and heating cost being equal, as they should. The same value of k gives

$$E_{n-1} = \frac{1}{n-1}\sqrt{\frac{n}{2}} . C\,R + C\,r$$

as the corresponding difference of potential at the terminals of each of the $n - 1$ dynamos.

"Substituting now in these different expressions, and also in corresponding ones for the Edison system and for Prof. Carhart's plan, values of n from 2 to 6, we have the various data given in the following table :—

No of conductors.	Cross-section of each.	Difference of potential at terminals of each dynamo.	Interest on conductors.	Heat-waste in conductors.	Running expense of conductors.
		EDISON'S SYSTEM.			
n.	$\frac{1}{(n-1)^2}$	$\frac{(n-1)^2}{(n-1)(n-1)}$ CR+Cr.	$\frac{n}{2(n-1)^2}$.	$\frac{(n-1)^2}{(n-1)^2}$.	$\frac{n}{2(n-1)^2}+1$
2	1·000	1·000 CR + Cr	1·000	1·000	2·000
3	0·250	1·000 ,, ,,	0·375	1·000	1·375
4	0·111	1·000 ,, ,,	0·222	1·000	1·222
5	0·062	1·000 ,, ,,	0·156	1·000	1·156
6	0·040	1·000 ,, ,,	0·120	1·000	1·120
		PROF. CARHART'S PLAN.			
n.	$\frac{1}{n-1}$.	$\frac{1}{n-1}$. CR + Cr	$\frac{n}{2(n-1)}$.	$\frac{1}{n-1}$.	$\frac{n+2}{2(n-1)}$.
2	1·000	1·000 CR + Cr	1·000	1·000	2·000
3	0·500	0·500 ,, ,,	0·750	0·500	1·250
4	0·333	0·333 ,, ,,	0·667	0·333	1·000
5	0·250	0·250 ,, ,,	0·625	0·250	0·875
6	0·200	0·200 ,, ,,	0·600	0·200	0·800
		THE MOST ECONOMICAL PLAN.			
n.	$\frac{1}{n-1} . \sqrt{\frac{2}{n}}$	$\frac{1}{n-1} . \sqrt{\frac{n}{2}}$ CR+Cr	$\frac{1}{n-1} . \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} . \sqrt{\frac{n}{2}}$	$\frac{1}{n-1} . \sqrt{2n}$
2	1·000	1·000 CR + Cr	1·000	1·000	2·000
3	0·408	0·612 ,, ,,	0·612	0·612	1·225
4	0·236	0·471 ,, ,,	0·471	0·471	0·943
5	0·158	0·395 ,, ,,	0·395	0·395	0·791
6	0·115	0·346 ,, ,,	0·346	0·346	0·693

"Some very interesting comparisons of relative advantages might be noted, did space permit. The most important is the rapid increase in the ratio of heat-energy to capacity of conductor in the Edison system, which might make it necessary to lay the wires so as to admit of pretty free radiation of heat.

"This question of temperature of electric lighting conductors promises to protrude itself the more they are laid underground. The desideratum for an insulating covering would seem to be a non-conductor of electricity and good conductor of heat—apparently inconsistent qualities. Perhaps the eventual solution will be in bare or loosely covered wires on highly insulated points of support, thus admitting of free radiation of heat, like aerial lines."

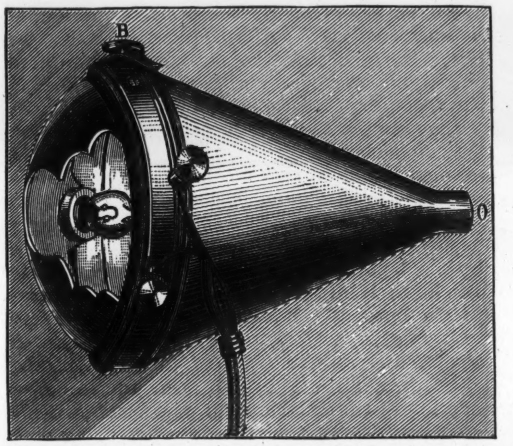
THE OTOSCOPE.

PROF. LEON LE FORT has recently submitted to the Academy of Medicine, in the name of Dr. Rattel, a new otoscope, an apparatus for illuminating the interior of the ear, which *La Nature* describes as follows :—The instrument is illuminated by a small incandescence lamp with carbon filament. The lamp, which is of 2 candle-power, is placed in the interior of the instrument. An accumulator yielding 13 ampère-hours is capable of lighting it during a minimum of 6 hours.

The reflector forms a portion of an ellipse, one of its foci corresponding with the lamp, and the other with the extremity of the instrument.

A commutator allows of establishing or interrupting the current at will. A rheostat in connection with the accumulator renders it possible to graduate the light by causing the filament to be heated from redness to a maximum of incandescence.

The opening by which the observations are made is of such dimensions as to allow the passage of any instrument necessary for the treatment of the diseases of the ear.



This mode of lighting and of reflection may be applied to a Brunton otoscope, which is used for the examination of other natural cavities, such as the nose, the pharynx, &c. Elliptical reflectors do not appear to have been hitherto brought into use.

By way of conclusion Prof. Le Fort contends that this new and essentially practical otoscope supplies a real want and that it appears to be destined, thanks to its excellent arrangements, to render great service in the treatment of the diseases of the ear.

Dr. Rattel's apparatus has been constructed by M. Galante. Our engraving shows how it is arranged.

COST OF ELECTRIC LIGHTING BY INCANDESCENCE.

M. BASTET, engineer in chief of bridges and roads, and also charged with the superintendence of the lighting, the walks, and the concessions of the City of Paris, has published a summary of the principal results of the installation of the Edison system of the Town Hall.

The conclusions he has arrived at as regards the cost of the electric lighting by incandescence differ from the opinions generally adopted to such an extent, that we (*Bulletin International des Téléphones*) have taken the trouble to study his paper, and to point out therein some very serious inaccuracies.

Why does M. Bastet calculate the charge for depreciation and interest for a twelvemonth, when his other figures relate to a space of six months only ? The rectification of that error alone would result in the reduction of the total cost from 24,806 fr. to 19,806 fr., and of that of the lamp hour from 0·1260 fr. to 0·0981 fr.

Why is the staff in attendance at the Town Hall double that which is strictly necessary ?

Why does the installation of 900 lamps, A, of 16 candle power, to which his paper relates, feed in reality 500 lamps only ?

Why is the cost of the gas calculated, as if it were burned in a laboratory, at the rate of 105 litres for a pressure of from 2 to 3 mm. of water, when those purely theoretical figures should, in practice, be increased by 25 to 30 per cent. ?

Why has the charge for the interest on the cost of the first installation of the gas not been taken into account?

Why has the cost of the fuel for the engines been calculated at 42 fr. per ton, when coal of a good quality can be obtained at 25 or 30 fr. per ton?

Leaving those details out of consideration, and placing himself, as it were, in very unfavourable conditions, as regards costs, M. Bastet is led to the statement that, for equal lighting power, the incandescence light is 2·17 times as expensive as the gas.

Now, by taking the trouble to make our own calculations, making due allowance for depreciation of plant, and for interest on outlay for the gas as well as for the electricity, and with a real, and not a theoretical, consumption of gas per jet, we find that the electricity is scarcely 20 per cent. more expensive than the gas at 0·30 fr. per cubic metre; and if the installation is properly conducted, the difference will be all in favour of the electricity, as is proved by the numerous installations executed by the Edison company in spinning and weaving establishments.

M. Bastet's paper is another proof that Town Councils do not understand, any more than the State does, those questions which are properly within the province of private industrial enterprise; and we can easily foresee what would become of the gas industry were it to fall into the power of the Municipal Council of Paris.

INDUCTION AND CONDUCTION.

By WILLOUGHBY SMITH.

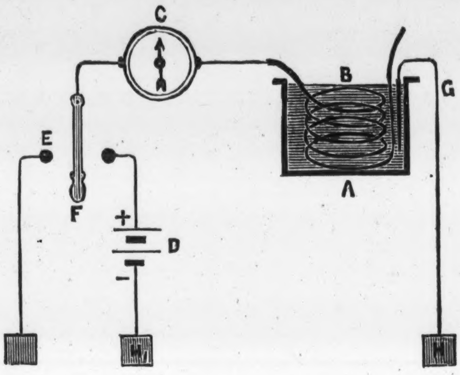
ONE hundred years had passed since the discovery of the Leyden jar, and many earnest experimentalists were still striving to discover new facts which would enable them to fix the true theory and laws of induction on a secure and lasting basis, when our immortal Faraday published, through the Royal Society, the results of his researches. By the light of Faraday's genius, so brilliantly shown forth in that paper, the theories of induction were to my mind totally eclipsed, and the true theory and *great importance* of induction brought vividly to view. By his masterly reasoning powers and the delicate manipulation of his judicious experiments, he demonstrated the fact that induction is the result of an action of contiguous particles, which action is set up by the electrified body, and consists in a species of polarity; the particles assuming positive and negative parts, which are symmetrically arranged with respect to each other and the inductive surfaces producing the effect. He also to my mind proved the correctness of his theory by establishing experimentally the following facts: "That non-conductors as well as conductors have never yet had an absolute and independent charge of one electricity communicated to them and that such a state of matter is impossible." "That charge always implies induction." "That all charge is sustained by induction." "That induction is the essential function both in the first development and the consequent phenomena of electricity." "That electricity is retained upon the surface of conductors only by induction," and "That conduction is always preceded by atomic induction." Through the light of his imagination Faraday saw with perfect clearness, that the action on the particles of conductors differed only in degree from the action upon the particles of a dielectric, and that the particles of a conductor became polarised in the same way as those of a dielectric, but with greater ease and rapidity, thus constituting what is termed "conduction." I cannot but express my surprise and regret that the clear views of Faraday have not, long since, received that general acceptance which I venture to assert they so richly deserve, and also that even at the present day theories are propounded which, although marked by the sincerity of the propounder, will not bear even the dullest light of criticism.

Frequently whilst employed in making tests in induction in its various forms, either experimentally or otherwise, phenomena, strange and mysterious, have perplexed and troubled me; but by carefully examining them in the light of Faraday's hypothesis I have generally been able to rightly interpret that which at first seemed so foreign and unintelligible.

By the aid of diagram I., I will explain what I mean by "charge," "polarisation," "discharge," and "residual discharge," or what I think would be more correctly termed "depolarisation."

The results given were obtained by actual experiments with the apparatus as shown. A, represents an insulated tank in which is sufficient water to immerse the coil of insulated wire marked B. A copper plate was also immersed in the tank and connected to earth by the wire, G. The galvanometer, C, was an astatic mirror reflecting one, and the terminals were connected, one to coil B, and the other to switch F, which was so placed that it could be brought into contact either with one end of the battery, D, or the earth wire, E. The other end of the battery was connected to earth.

DIAGRAM I.



1	2	3	4	5
TIME.	CHARGE.	POLARISATION.	DISCHARGE.	RESIDUAL DISCHARGE.
	27,400		27,400	
1′	——	23	——	1,510
2	——	17	——	422
3	——	15	——	248
4	——	13·5	——	154
5	——	12·5	——	117
6	——	11·5	——	90
7	——	11	——	75
8	——	11	——	65
9	——	11	——	56
10	——	11	——	48

Immediately F was connected to one pole of D a strong current entered coil B, and the magnet of C was powerfully affected. One end of B being insulated, this phenomenon is called "charge," and the strength of the charge in this particular experiment, had no shunt been used, would have equalled 27,400 divisions on the scale of C. After the deflection due to charge, the magnet returns towards zero, at first rapidly and then more slowly. The actual figures are given, and it will be seen that at the end of the tenth minute after contact the deflection had fallen from 27,400 to 11. This fall is known as polarisation or electrification. At the end of the tenth minute F was disconnected from the battery, D, and connected to earth by means of E, and a deflection of 27,400 divisions was at once observed at C, but of course in the opposite direction to that of the charge; this is known as discharge. After the discharge, if F be insulated for one minute, and then again connected to E more current will flow from B. This is known as "residual discharge," or what I prefer to call "depolarisation."

The deflections obtained in this experiment of depolarisation are given in column 5, and it will be seen that they are totally different from those given in column 3. This difference is owing to the nature of the two tests. In the test for polarisation, F was kept in contact with the battery for the whole of the ten minutes, the amplitude of the deflection being noted at the end of each minute; but in the depolarisation test, F was momentarily connected with E, and then disconnected for one minute when another momentary contact was made, and so on for the ten minutes, the deflection being noted at the same time that the contact was made; for if, after the discharge had taken place, F were allowed to remain in contact with E, then the deflection on the galvanometer would be very low on account of the comparatively short length of insulated wire used; consequently, I thought it better to measure the depolarisation current by means of time accumulations. But, when possible to do so by direct deflection, it is found to be approximately equal, at the first minute, to the difference between the first and last minute's deflection of the polarisation current.

Now, in an experiment of this nature, Faraday would have conceived that as soon as F was connected to the battery, D, each molecule of matter forming what is termed the circuit, would become polarised, and by that means produce a current. Now, as I understand it, the molecules of the copper wire starting from the battery, D, would first polarise in succession; next, the molecules of the gutta percha surrounding the wire, then the molecules of the water in the tank, followed by those constituting the copper plate and wire, G, then the molecules of the earth, and, finally, the copper plate and wire in connection with the other end of the battery, D. The matter in the circuit offering the greatest resistance to polarisation would, in my opinion, regulate the amount of current produced. In this experiment the strength of the current would be regulated by the thickness of the gutta percha surrounding the copper wire of coil B.

One test of the correctness of such a view is, that the effect upon the galvanometer ought to be the same, no matter where placed in the circuit. To prove this, a similar galvanometer to C was placed in the circuit between the copper plate immersed in the tank, A, and the earth wire, G, another exactly similar being placed between the copper earth plate and the battery, D; on repeating the experiment it was found that all three galvanometers were affected in precisely the same manner, that is to say, they all deflected to a similar number of divisions for charge, polarisation, discharge and depolarisation; and, therefore, to measure the value of the potential in these tests, it is quite immaterial in which portion of the circuit we place our instrument. Great care, however, is necessary that all apparatus used in experiments of this nature, should be well insulated, as it is obvious that the more perfect the insulation the more perfect will be the results obtained. Although I have imagined Faraday tracing the current, in polarised lines, through the earth from the one earth plate to the other, yet I am unaware of his actual views as regards the part played by the earth in such a circuit, nor am I acquainted with any experiments of his bearing upon the subject.

That there are many and various opinions as to the important part played by the earth in such a circuit, is evident from the following extracts taken at random from a few works on electrical science. In the first the student is requested to "Regard the earth as a reservoir in which the positive electricity on the one side and the negative on the other are absorbed and lost." In another, he is asked to "Regard the earth as a huge reservoir highly charged with positive electricity, and to regard a telegraph or a battery as an arrangement by which the electricity is pumped out of it at one point and poured into it at another."

A third says: "The earth being regarded as an inexhaustible reservoir of electricity, offers no sensible resistance to the passage into it or out of it of any quantity of electricity, in the same way as the ocean would supply or receive at any point an indefinite quantity of water, and this is equally true whether the points be close together or in different parts of the globe."

Another states: "Thus, when the extremities of a circuit are connected to the earth, which is an infinitely large conductor, their respective tensions are diffused in all directions without producing any appreciable alteration of tension in the earth itself, so that the current will continue to flow."

A fifth says, "The terrestrial globe is a vast reservoir or species of drain which sucks up and absorbs at the two extremities of the wire the free electricity which the battery, or any apparatus that is the generator of electricity, sends into it." I might continue quoting, but think that I have done so sufficiently to make it plain that all are not agreed as to the correct hypotheses of this remarkable phenomenon, and also how bewildering it all must be to the student who is endeavouring to arrive at the truth.

If Faraday's theory be correct, then the earth must play the part of a conductor and become polarised in the same way as any other part of the circuit. I therefore endeavoured to ascertain the potential of the current passing, if it really did pass, in the earth circuit; and the results which I at first obtained appeared exceedingly puzzling. There was no difficulty in proving that the potential at each earth plate (H and H_1, diagram I) was the same; but I found that the potential of the earth, using water as such, in a straight line between the two plates was much less than that of the other part of the circuit and not only less, but variable.

This fact would appear at first sight sufficient to overthrow the hypothesis I hope to establish, but after a little thought all became clear; the apparent anomaly vanished, and the correctness of Faraday's sound reasoning more evident. I had only to remember the tendency possessed by an electric current of distributing itself throughout the whole extent of the conductor through which it is passing, and all became clear and intelligible. There are several ways whereby the distribution of the current can be experimentally demonstrated; for instance, if into an uninsulated iron tank filled to within a few inches of the top with water, be immersed, at any depth or distance apart, the two wires of a battery of any desired intensity, it will be found that the current distributes itself throughout the whole of the water, radiating in lines from the one end of the battery to the other. In order to trace the direction of those lines, divide the surface of the water into squares of about one inch; this can be done by placing a wooden frame intersected with fine wires or threads the desired distance apart over the tank, and just above the surface of the water. Two wires are then taken, one end of each being firmly fixed a definite distance apart, the other ends being joined to the terminals of a suitable galvanometer, and inserted through one square into the water; the deflection being noted, the wires are then inserted through the next square, and so on. By tracing lines through the points of maximum potential of each square, the direction of the current can be ascertained and illustrated as shown in diagram II.

The experiment from which the results here shown were obtained, was as follows:—

An uninsulated iron tank 6·5 feet long, 5 feet wide, and 3·3 feet deep, was filled with water (about 676 gallons) and the surface divided off into sections of one square inch by means of the arrangement already described. The two ends of a battery of twenty Leclanché cells were attached respectively to two circular copper plates 3·5 inches in diameter and immersed six inches below the surface of the water, and 3·3 feet apart as shown in the diagram. The two exploring wires in connection with the galvanometer were ·038 inch in diameter, and insulated so that only a cross section of each wire would be in contact with the water. The ends of these wires were fixed parallel to each other half-an-inch apart, and so arranged that the uninsulated ends should be immersed below the surface of the water in each test. These two wires so fixed and immersed were moved in each section until the position of maximum potential was obtained; this is represented by the curved lines in diagram II., fig. 2. In this manner I was able to trace some of the lines of polarisation into which the current divided itself, not only from its original source, but also its unerring return to the same.

DIAGRAM II.

FIG. 1.

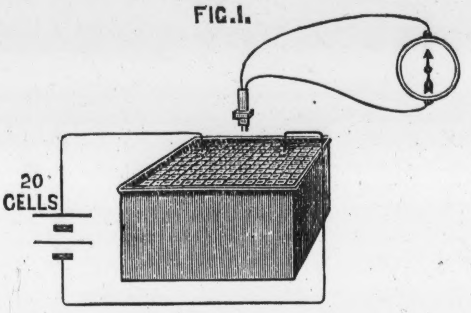
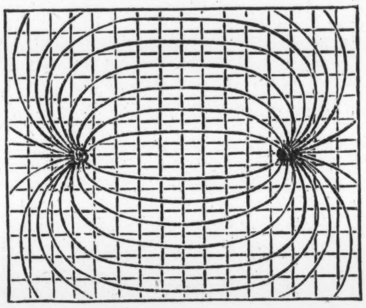


FIG. 2.

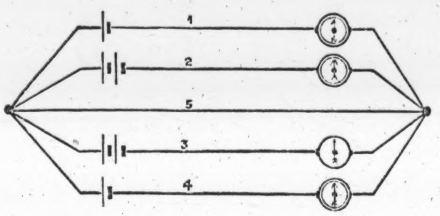


In my paper on "Volta-electric induction," which I had the pleasure of reading at the meeting of the Society of Telegraph Engineers and Electricians on November 8th, 1883, I then showed that magnetic lines of force emanating from flat spirals of copper wire, through which intermittent currents of electricity were passing, in no way interfered with each other in their passage through air, but that each line or lines returned, in curves to the source from which it started. Now, precisely the same law, as far as I have been able to ascertain, applies to electric currents passing through a conducting medium; that is to say, the currents disperse themselves over the whole substance, each returning to the source from which it started, without in any way interfering with the others. As I have just shown, the lines of direction of the currents can be traced by shunting a portion of the current through a galvanometer; or, in the case of intermittent currents, through a telephone. To prove that there is no blending or interference between independent electrical currents, when traversing a body of water or other conductor, it is only necessary to form two circuits through the water from independent batteries, one circuit being made intermittent by an automatic tuning fork, and the other by some different form of "make and break," then positions can be found in which the two exploring wires connected to the telephone will form a shunt circuit in the water to either the tuning fork circuit *alone*, or to the "make and break" circuit *alone*, the sound produced by the particular intermitter being reproduced in the telephone, indicating, thereby, the particular current that is producing the effect. I think it is fair to assume, from the full knowledge of the results of experiments of this kind, that the current passes through the earth or water, which amounts to the same thing, as through an ordinary conductor, in dispersed and curved lines. How far such curves extend I am not prepared to speak positively, but, if I might venture from the firm ground of experiment to the less stable one of theory, I should say they extend over the whole world, and that what are termed the magnetic poles of the same, are the immediate cause of the lines assuming the curved form. The experiment further shows that, from whatever source a current emanates, it will diffuse itself over the whole mass of matter interposed, without in any way mixing or blending with a current or currents emanating from any other source or sources. The nearest analogy to this which I can think of is, that the mind of each human being in this world of ours is constantly directing what are called lines of thought from its brain, or battery, far and wide, and those numberless lines of thought, so far as our own knowledge extends, never blend or become confused, but go and return each one to the source from which it emanated in precisely the same way as lines of electromotive force, when similarly manipulated.

Another instance of the divisibility of currents and their non-interference or blending with each other whilst passing through the one and same conductor is illustrated in diagram III., which represents four distinct circuits of insulated copper wires, using one similar wire as part of the circuit for each of the other wires.

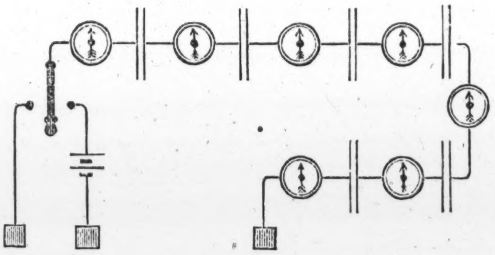
In this experiment all the four currents of varying potential in the separate wires marked respectively 1-2-3-4 passed through the one wire marked 5, without any apparent influence or interference with each other, just as the various currents of the telegraph systems of the whole world, wherever it is employed as part of the circuit, traverse the earth independently of each other. Messages by electrical signals have been sent and correctly received through a submarine cable two thousand miles in length, the earth being one half of the circuit, by the aid of the electricity generated by means of an ordinary gun cap containing one drop of water; and small though the current emanating from such a source naturally was, yet, I believe, it not only polarised the molecules of the copper conductor, but also in the same manner affected the whole earth through which it dispersed on its way from the outside of the gun cap to its return to the water it contained. I further believe that the time will come, perhaps sooner than may be imagined, when it will be possible to detect even such small currents in any part of the world, in the same way that it is now possible to do in comparatively small sections of it. To instance thoughts which such facts naturally suggest to a contemplative mind, would be somewhat foreign to my present purpose, I will therefore merely remark that, as the experimentalist advances in experience, he will more readily admit his conviction that the time is fast approaching when the fundamental laws of nature will prove to be both few and simple; not "many and complicated," as men now classify them through ignorance.

Diagram III.



To make sure that the self induction in the coil B, diagram I., the length of wire in this coil being one mile, did not influence the results, and also to further extend the experiment, a circuit was made up of condensers of different capacities, and galvanometers as shown in diagram IV. The deflection on each galvanometer was the same, both in amount and direction, for charge, discharge, polarisation, and depolarisation. It was also found to be immaterial how the condensers were placed, as the results were always the same. Neither did it matter whether the circuit was completed by connecting one terminal of the last galvanometer direct to the copper plate of the battery or by making earth as shown in the diagram. The condensers were then replaced by resistance coils of different values, but the results were the same in every respect.

Diagram IV.

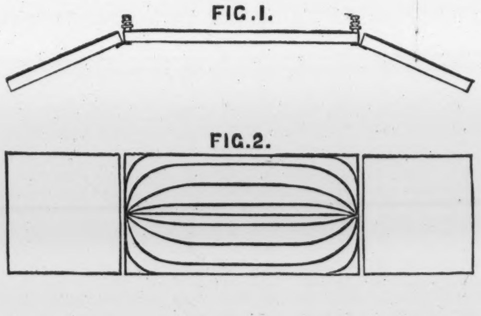


If Faraday's hypothesis be correct it may be said with apparent justice, that conduction as well as induction is the effect of polarisation, then, the higher the resistance of a substance the lower should be its inductive capacity; that is to say, it would be impossible to have high resistance and high inductive capacity in the same substance. Now, I only think it fair to admit, that I have on several occasions obtained results which did not appear to be in accord with this aspect of Faraday's theory; that is, I have had substances which gave very high resistance and a comparatively high inductive capacity, and others which gave a comparatively low resistance and at the same time a comparatively low inductive capacity. For a long time this anomaly both puzzled and annoyed me; but when I discovered that substances which are called conductors, differ materially in effect of polarisation according to time, I saw, to my own satisfaction at least, the solution of the whole matter. In my paper on "Volta-electric induction," to which I have already referred, and also more fully in my lecture on "Volta and magneto-electric induction," which I had the honour to deliver at the Royal Institution on June 6th, 1884, I showed that the percentage of inductive energy intercepted does not increase for different speeds of the reverser in the same ratio with different metals; the increase with iron being very slight, whilst with tin it is comparatively enormous. At the same time I proved that time was an important element to be taken into account in experiments of this nature; that is to say, lines of magnetic force take an appreciable time to polarise the metal placed in their path; but, having accomplished this, they pass more freely through it. Now, we know that all substances are more or less conductors of electricity, therefore, it is but fair to suppose, that those known as dielectrics follow the same law in this respect as the more perfect conductors, such as the various metals. In tests for the inductive capacity of dielectrics, time is not, nor can it be, taken into account, but it can and should be in tests for insulation, and those familiar with such tests must have observed the great differences which exist in the polarisation of different dielectrics in equal portions of time, that is to say, one dielectric may test higher than another at the end of the first minute's polarisation and lower at the tenth minute. It is therefore clearly incorrect to assert that one dielectric has a higher resistance than another; all that can be absolutely stated is, that the resistance is higher or lower after a definite time of polarisation. And I am convinced that these apparent anomalies in no way lessen, but rather tend to strengthen the correctness of the hypothesis I am so desirous should be fully recognised; for I can see how satisfactorily many of the phenomenal problems, that at present preplex and worry the earnest investigator, might be solved, if the powerful light of Faraday's imagination were used to lighten the present darkness. For instance, since the first introduction of electric telegraphy, more especially the submarine branch of it, the practical telegraphist has been troubled and annoyed by currents of electricity which affect the instrument in their passage from the earth to the line conductor, or *vice versâ*. These currents, which are very capricious in intensity, direction, and duration, are termed "earth currents," and many theories have been advanced to account for their presence, but no satisfactory solution has been given, and the subject is still attracting attention. Now, supposing that the polarisation theory were admitted, then I think it would be seen that these currents might proceed from various causes, such as the evaporation and condensation of watery vapours, volcanoes, combustion, Aurora Borealis, junction of opposite currents of wind, or a high wind against opposing objects, or from the Torpedo, Gymnotis Electricus, and other electrical fish while in a sportive mood or in search of food.

While writing on subjects of this kind how difficult it is to prevent the imagination from taking possession of the pen and often carrying it far beyond the control of apparent reason. Often, whilst engaged in preparing this paper my thoughts have irresistibly wandered far and wide even from the terrestrial to the celestial worlds; but as I prefer to give experimental facts rather than theoretical speculations, I will return to firm ground, and give the result of an experiment bearing on the subject, which to me has been of great interest.

Fig. 1, diagram V., represents a board 12 inches long, 6 inches wide, and ½ inch thick. The top surface is covered with tinfoil which is marked into sections of 1 inch square. At the extreme end are fixed, so as to be in good contact with the tinfoil, two terminals as shown. To each end of the board is attached a similar piece of wood, but of half the length, also covered with tinfoil and divided into squares in precisely the same way. These end pieces are attached by hinges, so that when placed as shown in fig. 1, their surfaces of tinfoil are not in contact with the foil on the centre piece. Now, if, when in that position, the resistance of the tinfoil on the centre board between the two terminals be balanced by an ordinary bridge arrangement, and while so balanced, the lines of the current passing through it be traced in the manner described and illustrated in diagram II., then the curves shown in diagram V., fig. 2 will be obtained. But, if the end pieces be raised so as to bring the surfaces of tinfoil into contact, the resistance of the portion under test will immediately decrease, and, consequently, the balance be destroyed, and if the

Diagram V.



lines of force be again traced they will be found to be as illustrated in fig. 3 of the same diagram. I learn from this experiment, that it is not correct to bisect either the standard or the substance under test, as is frequently the case when measuring the conductivity of metals of low resistance. For, from the results of this experiment, it is quite plain that the length and mass of the section beyond the points of contact, influence the correctness of the results.

ELECTRIC LIGHTING RULES IN SWEDEN.

THE following code of rules has been drawn up by the Fire Insurance Companies in Sweden :—

I. DYNAMO MACHINES.—The dynamo machine must not be erected in factories or rooms containing inflammable materials or explosives. The machine must be placed on a fire-proof bed, which must extend not less than 30 cm. beyond the commutator.

An insulating layer of wood may, however, be placed between the machine and its bed. A current or tension meter must be provided.

II. CONDUCTORS.—A sufficient number of safety apparatus must be provided, so that the current may be interrupted if it should, from any cause whatever, become so intense as to raise the temperature of the conductors to such a degree as would cause risk of fire.

The cross-section of the conductors, when of copper, must be so arranged that in the case of the arc light the strength of the current does not exceed 2 ampères per square millimetre, and in the case of the glow light

3 ampères per 1 □ mm. for currents of 50 ampères
2·5 " " " " 100 "
2 " " " " 300 "

and proportionally for stronger currents.

When the conductors consist of any other metal the dimensions must be fixed with due regard to the properties of that metal.

In the case of arc lamps the distance between insulated wires, through which currents of different potentials pass, must not be less than 50 mm. for 120 V. difference. This distance is to be increased by 25 mm. for each additional 60 V. difference ; but 300 mm. will be sufficient in all cases.

In the case of incandescence lamps, the distance between the insulated main conductors, through which currents of different potential flow, must not be less than 50 mm.

But in the case of branch lines this distance may, if necessary, be somewhat reduced.

Between uncovered wires, when they are carried over the roofs or in the neighbourhood of buildings, the distance must be at least five times that between insulated wires ; but 600 mm. will be sufficient in all cases.

Where wires cross each other they must be carefully fixed and separated from each other by some insulating and not easily inflammable material.

Where the wires are subject to more than usual wear and tear, they must be satisfactorily protected by additional special means.

Such wires as are led along iron bars or lamp posts, &c., must be insulated with extra care.

When metal bars or lamp posts, &c., are used as conductors, they must be insulated.

The use of the earth as a return circuit is not allowed. The wires in the immediate neighbourhood of the electric machine, as well as the leading in wires in buildings, must be provided with one or more cut-out apparatus by which the current may at once be interrupted.

The following additional rules must be observed for the conducting wires :—

INSIDE THE BUILDINGS—All wires must be carefully fixed and satisfactorily insulated. In damp localities extra care must be taken in that respect, and the wires must be insulated with gutta percha, or some other insulating material. All connections must be effected by soldering, or by binding screws, which must be insulated by means of so-called insulating tape, or of some other insulating material.

Wires which pass through walls and roofs must be protected by tubes of ebonite, glass, porcelain, or some other suitable covering ; and where two wires must, of necessity, pass through one and the same opening they must be firmly enclosed in a tube of some insulating and not easily inflammable material.

When there is a free span of some metres inside buildings, the wires must be kept apart at a distance of at least 30 cm.

For portable lamps double flexible wires may be used, provided they are well insulated.

Outside the buildings, uncovered wires suspended on insulators may be used ; but for such wires the above rules regarding the distance of the wires from each other will be enforced.

III. ELECTRIC LAMPS (A).—Arc lamps must be enclosed in glass globes or lanterns, which must be perfectly closed at the bottom by an ash holder. Arc lamps, are, however, not allowed to be used in localities where there are easily inflammable substances or explosives.

(B.) Incandescence lamps may be used everywhere, but they must be enclosed in strong glass globes, and provided with cut-out apparatus in such localities where there are explosives, or in which the atmosphere may become charged with explosive gases.

REVIEWS.

Technological Dictionary of the Physical, Mechanical, and Chemical Sciences. Part I., English-German. By F. J. WERSHOVEN. London : Symons & Co., 27, Bouverie Street, E.C.

The attempts which are made from time to time to compile technological dictionaries are never successful ones, and the attempts are the least successful when several sciences are grouped in one volume, or set of volumes. We are not at all surprised at such failures, as the subject is surrounded with difficulties which it would require almost superhuman knowledge to surmount. The failures are not those of incorrect translation, but of paucity of words; the latter often being those of very ordinary use. Take, for instance, the present volume, which professes to deal with "Mechanics ;" we look in vain for words relating to the different parts of an ordinary lathe, we cannot find "headstock," "back centre," "slide rest." If we come to clock and watchmakers' tools, the words expressing the latter are wholly absent. Such an ordinary word as "pliers" is not to be found. In fact, as is the case in all technological dictionaries we have come across, whenever we look out for the translation of a word we require it is almost sure to be left out. Undoubtedly, the "Technological Dictionary" of Messrs. Symons is a handy little book, and contains a great deal of information ; but it is very far from being perfect, although in the preface it is stated that "all" terms are included.

L'Année Electrique, ou Exposé Annuel des Travaux Scientifique des Inventions et des Principales applications de l'Electricité à l'Industrie et aux Arts. By Ph. DELAHAYE. First year. Paris : Librairie Polytechnique, Baudry et Cie., Libraires-Editeurs, 15, Rue des Saints-Pères.

In this work we have a well-written *resumé* of the progress which electric science has made within the last few years. A great deal of most useful reference information is given. Thus, in the first chapter, in which electric lighting is dealt with, the details of several installations are given, and the cost of the various items which relate to the same are stated. The same remarks also apply to the next chapter, in which "Batteries and Accumulators" are described; and, indeed, throughout the work, information of a like kind is given in a condensed and well-arranged form. Altogether, we consider that M. Delahaye's book is a meritorious one, and reflects great credit on its author.

ELECTRIC LAUNCHES.

THOSE who have taken any interest in the subject of "electricity as a motive power," must recollect that as far back as September, 1882, we recorded the successful propulsion of a launch by means of secondary batteries and electro-motors. The *Electricity*, which was designed in the summer of 1882 by Mr. A. Reckenzaun, under the auspices of the Electrical Power Storage Company, must be considered as the first really practical electric launch; that vessel was not a mere experimental toy, for she has made many trips on the River Thames, carrying passengers as well as goods of various description. The longest voyage on record with this launch, we believe, was that to Mortlake in the spring, 1883, during the University Boat Race; it was calculated that the *Electricity* made 40 miles on that day, and had still power to spare on her return to Millwall.

In Vol. XI. of the REVIEW Mr. Reckenzaun gave his views in an essay "On the Application of Electromotive Power to Maritime Purposes;" the uses and advantages of electricity for the propulsion of boats were therein set forth, and the experience gained at that period seemed to point to an early adoption of this new medium for inland navigation, at any rate for pleasure boats and the police service.

It cannot be said that there has been any lack of energy on the part of those who initiated the scheme of electrical navigation, for in the spring of 1883 a launch of much larger dimensions was completed and sent forth to the Vienna Electrical Exhibition by the joint effort of the Storage Company and Messrs. Yarrow. This craft, which for elegance, comfort, and fine workmanship can hardly be surpassed, was fully illustrated on page 104, Vol. XIV., of the REVIEW, with Mr. Reckenzaun's paper on electric launches, as read before the Society of Arts. In Vol. XIII. we gave, in full, the paper read by the same gentleman before the British Association at Southport; therein will be found the data requisite for equipping a boat with the necessary motive power. One pound weight of lead in the battery, it is said, will yield 1 horse-power of electrical energy per minute; this, we believe, has been demonstrated by the Electrical Power Storage Company.

Allowing for the loss necessarily arising through the transformation of electrical energy into mechanical power, we may safely assume that 120 lbs. of dead weight will give us 1 horse-power for one hour, useful, for propelling a vessel through the water.

We do not think that it will be possible to reduce the weight of lead accumulators materially, having due regard to durability in the conducting medium; nevertheless for special purposes, where the motive power apparatus may be destroyed as soon as it has accomplished its function, it may be practicable to arrange the materials so as to increase the storage capacity. The energy manifested in the separation of lead from its oxides is stated to be 360,000 foot-pounds per pound of metal; it is evident, therefore, that in the practically lightest storage battery only a fraction of the material is acted upon.

So long as lead has to be used for the storage of electrical energy, the speed, power, and distance to be traversed by electric boats will be limited. Eight miles an hour for six or seven hours appears to be the maximum hitherto attained; but the same apparatus which propels a vessel at a speed of eight miles per hour for seven hours, may produce for a short time a speed rate of ten or twelve miles per hour, if the motor is arranged to receive the extra current requisite for the corresponding motive power. The numerous steam cutters used in the British Navy might be replaced with advantage by electric launches; let their ordinary speed be seven or eight miles per hour, but give them the power to run at the rate of twelve miles, even if only for an hour or two. The same with police and excise boats. Whilst it requires two or three men to navigate a steam launch, one could attend to the electric launch; the available space on an electric launch is nearly double of that in the steam boat; or, in other words, for the same accommodation we can have a smaller craft requiring less motive power, therefore less expense. Moreover, for the services enumerated it is of the utmost advantage to move silently and emit no smoke.

The recent experiments on the Thames with an electrically propelled launch, carrying a powerful arc light and parabolic reflector, point to a further use of this system of navigation, for the same source of power supplies here two distinct and important applications. This last launch is fitted with a Reckenzaun motor, which has already found many useful applications, and about which we shall have more to say at an early opportunity.

NOTES.

Lighting the Mansion House.—The lighting of the Egyptian Hall and Saloon of the Mansion House by means of incandescent lamps, entrusted to the Hammond Electric Light and Power Supply Company a short time ago, having been completed, a successful trial run was made last week. The Egyptian Hall has 142 lamps, fitted in the following manner, viz.: 34 round the edge of the cornice, about 6 feet apart, and 108 on the 18 chandeliers between the columns. The saloon has 127 lamps fitted, viz.: 26 lamps in the dome, and the remainder on the chandeliers. The current is supplied by two Ferranti dynamos, one to each hall, driven by two 12 horse-power Clerk's patent gas engines, manufactured by Sterne & Co., of Glasgow. The two engines work on to one countershaft. This method, together with driving pulleys, having very heavy rims, used as flywheels, makes the light very steady. The whole of the generating plant is fixed in the cellars of the Mansion House.

Effects of a Sleet Storm.—At Dayton, Ohio, 150 electric light lamps were recently frozen up so that they could not be lowered for three days. In order to put in new carbons and keep the lamps burning it was necessary to employ ladders to get up to them.

The Electric Light Convention in America.—A meeting of electric light people in Chicago was held on the evening of February 4th to take the initiative with regard to the "electric light convention." All the companies in business locally were represented except the Edison, and the indications were, according to the *Electrical World*, that all would participate except that company and the Brush. The meeting was presided over by Mr. C. A. Brown, of the Western Electric Company, and the officers and committees were appointed. It was proposed to hold the convention on the 25th inst. Naturally, says our contemporary, the transmission of power must be considered as well as lighting, if the convention is held, and is to do anything like practical, beneficial work.

The Lighting of Chicago.—The City Electrician, in his report to the Committee on Gas, in which he was to make an estimate as to the amount which should be charged for lighting the new city hall and tunnels with the Edison incandescent electric light, strongly favours this system for these purposes. Mr. Geo. S. Bowen, of the Van Depoele Electric Manufacturing Company, claims that the city of Chicago could be lighted as cheaply with electricity as by gas, and that there would be saved to the city nearly $100,000 which is now expended for lighting and extinguishing the gas, for repairs, &c.

Crossed Wires.—In the Western Union building at Evansville an electric light wire recently came in contact with a telegraph wire, heating the latter to a white heat. The destruction of a few instruments resulted.

Electric Lighting at South Kensington Museum.—It has been decided to use a set of the Electrical Power Storage Company's accumulators for the maintenance of 100 lamps in the science and art department.

House to House Electric Lighting.—The letter from Mr. Geo. Offor, which will be found in our Correspondence columns, deals very fully with the Colchester installation. His explanation of the commercial failure of this enterprise places the matter in a more favourable light, and we really trust that some means may be forthcoming to enable the system to be carried out to a successful issue. We note with pleasure that Mr. Offor claims for the apparatus employed a scientific triumph, for it was on this score that we originally had the gravest doubts.

Central Station Electric Lighting.—It may not be generally known that the installation now being made at the Grosvenor Gallery is of far larger proportions than was originally contemplated. Steam power to the extent of over 600 indicated H.P. is being got ready, whilst the dynamos made by Messrs. Siemens Brothers & Co., Limited, are the largest yet turned out by that well-known firm. An excavation is being made under the Grosvenor buildings, the area being nearly 6,000 square feet, and in this large space the machinery will be placed. Being about thirty feet below the level of the street, and not being accessible from Bond Street, no nuisance can possibly arise from the presence of so large an amount of machinery. The system of distribution employed will be that of the secondary generators of Messrs. Gaulard and Gibbs, their new type of generators being employed. About 5,000 lamps are being let out at a rental which, while well paying the enterprising company taking the matter in hand, is willingly accepted by those who are anxious to be supplied with the new illuminant. Seeing that this is really the first serious undertaking of its kind which has been started in this country, the results will be eagerly looked for, and we have no doubt but that when once the lead has been given to undertakings of this description, should a favourable result be obtained, others on the same, or a larger scale, will speedily follow. At present a temporary installation is at work in Bond Street, supplying some 250 glow lamps upon the secondary generator system, in order to test its capabilities; and, so far, we understand, the result has been more than satisfactory, the current being perfectly under control. The whole of the arrangements, engineering and electrical, are being carried out on behalf of Sir Coutts Lindsay & Co., Limited, by Messrs. Mackenzie and Brougham, who are the engineers to the undertaking. We shall endeavour to give the fullest particulars when the work is completed, which will be in from two to three months time.

The Electric Light at the Elysée.—At a ball given by M. Jules Grévy at the Elysée, on the 19th inst., the ball rooms on the ground floor were lighted by 400 incandescence lamps. The current was supplied by ten batteries of Faure-Sellon-Volckmar accumulators. Each lamp was of 15 candle power. The installation was erected by Messieurs Beau and Bertrand Taillet, sole possessors of the right to use those accumulators for the illumination of *soirées*.

Electric Lighting and Billiards.—The management of the Bradford Café, one of the finest temperance establishments in the country, has introduced electric lighting experimentally in the billiard room, and, so far, the light has proved so satisfactory that an extension of its use is in contemplation. Two tables are lighted by it in the meantime, six 20-candle Swan lamps being suspended over each, while four more lamps are fixed to the ordinary gas brackets on the wall. The motive power is supplied by a two horse-power steam engine, and the dynamo is Schuckert's, for which Messrs. J. Roper and Co., who have fitted up the installation, are the agents.

The Electric Light in Powder Mills.—Messrs. Davey, Bickford and Watson's powder mills, near Rouen, have for several weeks been lighted by electricity. Edison lamps are placed in openings made in the interior of the walls, and protected by sheets of glass. By this arrangement all danger attending the manipulation of explosive substances by artificial light is avoided. The motive power is supplied by two gas engines each of 2 horse-power, coupled in such a manner as to secure a uniform rate of speed.

Gas v. Electric Light.—At the sixty-sixth half-yearly meeting of the Wolverhampton Gas Company, held on the 24th inst., the chairman, in moving the adoption of the report, stated that the competition from electric lighting had almost died away. In the future the light might seriously compete with the company, but the directors thoroughly believed that by that time there would be demands for gas for different purposes which would amply repay them.

Train Lighting by Electricity.—We give under a letter to which our attention has been directed, which appeared in *Engineering* subsequently to those we reproduced from that journal last week. It is from the pen of Mr. W. Langdon, and is mainly directed in reply to that of Mr. Massey, contained in our last issue. Mr. Langdon writes: "It was not my intention to have trespassed upon your paper by another word upon this subject, but it has occurred to me that it would be an injustice to the views to which I have given expression, did I not direct attention to the opinion expressed by the president of the Society of Telegraph Engineers in his inaugural address recently delivered before that society, when dealing with this branch of his subject. In the seventh paragraph of your article (page 103), commenting upon Mr. Spagnoletti's address, you remark, 'electric illumination promises to supply such a light; but Mr. Spagnoletti takes the view that it must be so arranged that however a train is disconnected and broken up, or has fresh carriages added, none of the carriages should be in temporary darkness.' It will thus be seen that I am not singular in advancing the theory that every carriage should carry its own lighting power; and I have little doubt that were the views of others possessing a practical knowledge of railway requirements ascertained, their views would be in accord with these expressed by Mr. Spagnoletti and myself. All questions of this character are naturally affected by that of cost, but cost is not the first factor. Whatever is the object there are certain essential conditions with which it is necessary to comply, and until these conditions are complied with it is needless to discuss the question of cost."

Provisional Orders.—Only one application has been made to the Board of Trade this year for a provisional order for electric lighting.

The Telephone and Fire.—In the annual report just presented to the Watch Committee of the Birmingham Corporation, it is stated that the reduction in the number of serious fires within the borough during the past year is due, in the opinion of the superintendent of the fire brigade, to the introduction of the telephone, which enables alarms to be given much more quickly. Many fire-alarms have been received through the Telephone Exchange, which has a wire in connection with the central fire station.

The Consolidated Telephone Company in New Zealand.—News comes from the Antipodes that Messrs. Chapman and Fitzgerald, solicitors for the proprietor of the *New Zealand Times*, have accepted service of writ and statement of claim at the suit of Sir Julius Vogel, claiming to recover £10,000 upon each of two counts alleging that certain articles and telegrams which have from time to time recently appeared in that paper on the subject of the Consolidated Telephone Company are libellous.

The Telephone and the Telegraph.—In America, we learn, "telephone" has once more been held to mean "telegraph." The courts in Pennsylvania have decided that the Pennsylvania Telephone Company must pay $345.04 under the law imposing a tax on the gross receipts of "every telegraph company" incorporated under the laws of the State, or any other State, and doing business in the Commonwealth.

Telephonic.—The houses of all the members of the Inverness Fire Brigade have been connected with the Police Office by telephone. To test the efficiency of the system one morning last week the alarm was struck at 5 o'clock. The first man arrived in response to the summons 2½ minutes thereafter, and all the members turned out fully equipped within 10 minutes.

Music by Telephone.—Last Tuesday evening, at Inverness, Mr. J. Townsend, district manager of the National Telephone Company, connected the Music Hall, where a concert was being given, with the telephone exchange, and several subscribers in different parts of the town were placed in communication. Two ordinary Blake transmitters were used, mounted on brass stands about 6 feet above the platform, and connected in multiple arc. In connection with the transmitters, Bennett's iron cells were used, each transmitter having two of what are called the "red" type in multiple arc. An ordinary gutta percha covered No. 18 copper conductor was used to connect the instruments, one or two of the lines being over a mile long. The concert was transmitted and received with the utmost success, being distinctly heard at the most distant point. Mr. Townsend intends to repeat the experiment in other directions.

Telegraphy in Japan.—In the twelve months reviewed by the last published report of the Director-General of the Japanese Government Telegraphs, the number of messages transmitted by the department was 2,836,221. Of these 2,773,644 were in Japanese, and 62,577 in foreign languages. The local messages in foreign languages numbered 30,423, and the international 32,154. As compared with the previous year, the traffic showed an increase of 51,934 messages. During the nine years the lines had been open, the messages had reached a total of 14,245,938. There were erected during the year 494 miles of line, and 1,774 miles of wire, and sixteen stations were opened for public traffic. In the preceding year the extensions measured 370 miles of line and 1,406 miles of wire.

Telegraph Revenue.—The receipts on the telegraph service, from April 1st, 1884, to February 21st, 1885, were £1,550,000, against £1,545,000 received from April 1st, 1883, to February 23rd, 1884.

The Atlantic Cables.—Speaking of the recent breakages in the Direct and other cables, the *Electrical World* says:—"It would be interesting to know what were the causes of these breakages. They have been attributed to earthquake, but without proof. The sooner the bottom of the Atlantic Ocean is thoroughly surveyed and mapped out the better it will be for the cable companies. There is still too much guesswork in connection with the few soundings taken."

The Zanzibar-Mozambique Cable.—The Eastern Telegraph Company announces the repair of the Eastern and South African Company's Zanzibar-Mozambique cable, thus re-establishing telegraphic communication with the East Coast of Africa, Natal, and the Cape of Good Hope. The directors have resolved to duplicate this section of the cable.

Cable Repair.—We learn that the ss. *Kangaroo* is now on her way home, after having effected the repair near St. Vincent of the first cable of the Brazilian Submarine Telegraph Company, which, we are given to understand from St. Vincent, has been broken down since the end of last year.

Proposed American Cable to Asia.—A bill has been introduced in the U.S. Senate to charter a telegraph cable between America and Asia.

A New Cable Ship.—We understand that the Telegraph Construction and Maintenance Company is about to increase its cable fleet by the addition of a new ship to be built by Messrs. Laird, of Birkenhead.

Secondary Batteries.—In a letter to *Engineering* Mr. J. S. Sellon, after replying to personal matters in Mr. Maxwell-Lyte's last letter on this subject, and stating that evidently they were not arguing on the same premises, says:—"The question of the storage of electrical energy is so vital, and has so important a bearing upon the future success and extended employment of electricity for lighting and motive power, that there appears to me to be at the moment no subject connected with electricity better meriting attention or more worthy of being taken up by those interested in its progress. Any dispute as to what one patentee or what another can do, or what rights they may respectively possess, is abstractedly of infinitesimal importance in comparison with the great problem of how the use of storage batteries can be best and most quickly developed; yet whilst the question of respective rights is undecided, progress must be stayed, as it is evident that before any of the various interests can be expected to enter upon competitive trials, the rights under dispute should be decided either amicably or in the courts of law. Legal proceedings on such scientific matters are much to be deprecated, if by any means they can be avoided, as entailing expense, delay, and uncertainty, and it is for this reason that I suggest that if a committee of three or four disinterested and distinguished men, such for instance as Sir Frederick Abel, Sir Frederick Bramwell, Sir William Thomson, and Professor Oliver Lodge, assisted by competent legal counsel, such as Mr. Webster and Mr. Moulton, would allow themselves to be nominated to hold a conference with the various secondary battery claimants, to go through the patents with them, and to weigh their respective claims, not only much expenditure of time and temper, but possibly many thousands of pounds would be saved to those who must otherwise become litigants, and a great and deserved impetus would be quickly given to one of the most interesting developments of electrical science. The decision of such a committee once given, comparative tests of the various forms validly claimed by the respective interests could doubtless be arranged to take place under the guidance of competent experts, and the existing uncertainties would probably at once and for ever be dissipated. I may be laughed at for advocating so new a departure from the general course in such matters, but I commend it to the judgement of all concerned as being well worth consideration in order to avoid wasting in the courts of law time, energy, and money, which would be better expended in pressing onward to success. I shall be pleased if any of those interested who approve of such a plan will communicate with me. To be of any practical good the scheme must be agreed to by all who put themselves forward as taking or wishing to take an active part in the work."

Post Office Protection Act.—At York on Monday the first case under the "Post Office Protection Act, 1884," was entered upon. Frederick William Evans, of 21, Heen Gate, York, was called upon to answer two summonses charging him with that he, being a Post Office telegraph clerk, transmitted to James Mason, of the Devonshire Hotel, Barrow-in-Furness, through the wires a private communication in reference to horse-racing. The defendant failed to appear, and the Bench issued a warrant for his apprehension.

"Bulletin de Société Belge d'Electriciens."—The fourth number of this journal has reached us; amongst the proceedings of the society are interesting articles on electrical accumulators, the inauguration of the Van Rysselberghe system, &c.

Mr. Cyrus Field.—From exchanges we learn that the action of Mr. William Abbot, at the recent meeting of the Anglo-American Telegraph Company, has caused considerable comment in cable circles on the other side of the Atlantic. The *Mail and Express*, a New York journal owned by Mr. Cyrus W. Field, devotes several columns of its issue of February 7th to Mr. Field's relations with the Anglo-American Cable Company, and to the recent efforts of Mr. William Abbott to secure Mr. Field's retirement from the board of directors. The article is entitled "Slander by Cable," and consists chiefly of cable correspondence between Mr. Field and his London solicitors. Editorially Mr. Field's journal speaks of Mr. Abbott as having been "disgracefully beaten" at the meeting of shareholders on the 6th. The article has this merit, says the *Financial News*, that it is the only really amusing story that the *Mail and Express* has been known to publish since it came into Mr. Field's hands.

The "Great Eastern" Steamship Company.—Mr. Justice Chitty, on Tuesday, ordered the appointment of a provisional liquidator, pending the hearing of a petition presented by a shareholder and debenture holder.

Severe Storm.—On Saturday afternoon and Sunday morning a violent storm of wind and snow was experienced on the east and west coasts of Scotland. In Ayrshire telegraphic communication was seriously interfered with. In Glasgow, and some other towns, overhead wires were broken. The Aberdeen telephone system completely collapsed. The strong iron standards were twisted in all directions, and the broken wires were dangling in the streets, to the danger of passengers. Fortunately the gale was at its worst during the night, or the results of the falling wires would have been serious. A railway porter was struck by a falling wire and sustained a severe cut on the shoulders. The telegraph wires did not escape destruction. Between Aberdeen and Stonehaven poles were blown down at exposed points, and at Fetteresso an early Sunday train cut through the wires which had been blown across the line. The telegraph lines on the Highland Railway, both north and south of Inverness sustained damage, and communication was totally suspended for several hours.

"Cast your Bread upon the Waters."—We understand that the ss. *Electra*, which has just been built on the Clyde, as an additional cable-repairing ship for the Eastern Telegraph Company, is about to be fitted with extra machinery for water-condensing, as she will probably be stationed at Suakim to make and store water for the troops. This is to be done, we understand, free of expense to the English Government. It is truly gratifying to find that in the present hard times there are directors who have aims above purely mercantile considerations.

"The Great Eastern."—This vessel, which was to have been fitted out as a floating hotel for the New Orleans Exhibition, is not likely to reach her destination just yet. Difficulties, financial and legal, beset the path of the "syndicate" which was formed in London with the object of bringing the matter to a practical issue, the date of sailing has been several times postponed, and the project is now in danger of complete failure. Whether the visitors to New Orleans during the next few months will ever cast eyes on the promised "marine exhibit and floating hotel" at all seems very doubtful.

The Cape Telegraphs.—Mr. James Sivewright, C.M.G., late of the Postal Telegraph Department and for the last seven years Director-General of Telegraphs to the Cape Government, has retired on a pension. Mr. Sivewright is well known for his energy in supplying telegraphic facilities during the Zulu war.

The Varley Patents Proprietory.—Notice is given of the dissolution of the partnership between F. H. Varley, J. R. Shearer, R. H. Padbury and Wm. Beale, electrical and mechanical engineers, trading under the style of the Varley Patents Proprietory, Mildmay Park.

Telephonic Receivers.—Mr. T. W. Giltay, writing from Delft on Wednesday, says:—In your issue of February 21st, "A. S. T. E." asks: "Have any of your readers tried a tinfoil condenser, as a receiver, over a considerable length of ordinary line wire?" According to M. du Moncel (le Téléphone, 4ieme Edition, p. 192), Dr. Herz has spoken with a tinfoil condenser as a receiver, over a line of 1,100 kilometers.

Re the Proposed New Atlantic Cable.—In an extract from a Portuguese newspaper, given in our last week's issue under a heading similar to the above, it will be observed that mention is made of a circular sent by the Brazilian Submarine Telegraph Company to its shareholders, to show the attitude of that company regarding the proposed lines for the Azores and North and Central America, as also for the Western Coast of Africa. As it, however, appears that this circular has been current in Portugal only, and as nothing seems to be known concerning it elsewhere, we think it only right to give our authority as fully as possible. The extract is from a well-known Lisbon paper, *O Egonomista*, of the 13th inst., and will be found in a "communicated" article, in Portuguese of course, signed: "The agent representing the Brazilian Submarine Telegraph Company, Limited, Fernando Luiz Mousinho de Albuquerque." The letter, after referring to the proposed Atlantic cable, *viâ* the Azores, as shown in the extract we printed, goes on further to point out the advantages which would accrue to the Portuguese Government by cancelling a provisional concession which it has already granted for cables to its African possessions; and by putting the whole matter in the hands of the "united companies"—the united companies being, as stated in the letter, the Brazilian Submarine, in accord with the Eastern Telegraph Company, and the Telegraph Construction and Maintenance Company. We do not think that the technical difficulties in the African portion of the system, mentioned by the circular, will be great; and, in any case, as pointed out recently in the money article of the *Daily Telegraph*, such cables are badly wanted, owing to "the great inconvenience caused by the interruption of the South African Company's cable," among other reasons. Any difficulty as regards the Southern portion of the system, to which the circular refers, would probably be, as recent experience shows, in the neighbourhood of St. Vincent. The part of the system which would be attended by some anxiety, would, however, be the Atlantic portion of the work, for, as may be seen on the chart, depths of 2,700 fathoms and more are found widely distributed over that portion of the ocean in which the proposed cable or cables would have to be laid, to the westward of the Azores. As regards the financial aspect of the project, no doubt the union of the African with the Atlantic sections of the work, would by means of the guarantees which might be offered on the African portion by the various Governments interested, render the idea as a whole, not altogether unwise, even in spite of the heavy competition; but it would perhaps give a more successful issue to the project if the directors of the Anglo-American Company were to allow some of their ample reserve fund, to be invested in securing for their company a share in this new Atlantic cable.

Long Distance Telephoning.—It is announced that the Belgian Government has entered into negotiations with the French and Spanish Governments for the purpose of making experiments with telephones on a line between Brussels and Madrid. If the respective Governments can come to a satisfactory understanding, Dembinski's microphone will be used. It is thought that this announcement requires confirmation.

Primary Batteries.—It appears that the oxide of copper battery of Messrs. de Lalande and Chaperon is beginning to be appreciated in France. We (*Bulletin International des Téléphones*) have been informed that 40 spiral cells of that system have recently been set up in the Paris Central Telegraph Office in the place of 200 Callaud cells. At a meeting of the old students of the Arts and Trades Schools, held at Rue Vivienne on the 31st ultimo, they were able to satisfy themselves of the advantages which the new battery of Messrs. Buchin, Tricoche & Co., possesses for electric lighting as well as for telephoning purposes. The room where the meeting was held was illuminated by three incandescence lamps, one of A. Gérard, and the other two of Swan. The lamps were in perfect action during the whole evening. The Gérard lamp, of 35 volts and 3·5 ampères, was lighted by two batteries of 25 cells, No. 2 pattern, filled with bichromate of potash and joined in parallel. The intensity of the light exceeded 50 candle-power. The Swan lamps, of 12 volts, were each worked by 10 bichromate of potash cells, No. 2 pattern. Telephonic communication was also established in the hall, the battery consisting of four bisulphate of soda cells, No. 1 pattern; the circuit was closed all the time, and although the battery was incessantly in action for four hours, the telephonic communication was at the conclusion of the meeting as clear and perfect as at its commencement. The abovementioned experiments, says the *Bulletin*, show that Messrs. Buchin and Tricoche may, with good reason, call their battery the "non-polarisable."

International Inventions Exhibition.—H.R.H. the Prince of Wales, as President of the International Inventions Exhibition, has delegated to a Commission selected from among the members of the Executive Council, the duty of making arrangements for the effective carrying out of the work of the International Juries. This Commission consists of:—Sir Frederick Abel, C.B., D.C.L., F.R.S. (chairman); Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E.; Sir George Grove, D.C.L.; Sir Edward James Reed, M.P., K.C.B., F.R.S.; Mr. John Robinson; Mr. R. E. Webster, Q.C.; with Mr. Trueman Wood, M.A. (Secretary of the Society of Arts), secretary of the Commission. His Royal Highness has expressed his wish that, as was the case in the International Health Exhibition last year, the exhibitors should themselves aid in the selection of jurors, by submitting the names of those gentlemen whom they may consider most eligible. Exhibitors will, therefore, be asked to send in on a form, to be provided for the purpose, names of gentlemen who might be invited to serve as jurors. The actual selection of jurors will rest with the Jury Commission, who will endeavour to give full weight to the opinions expressed by exhibitors, but will not be restricted to the list of names suggested.

The Soudan Campaign.—The cable ship *Calabria*, now fitting at Woolwich, which is to be stationed at Suakin, has 10 condensers, each of which will distil 10,000 gallons of water per day. As the *Calabria* will be the headquarters of the chief transport officer, she takes six miles of telegraph cable for telephonic communication with the other ships and the shore. She also has 3,000 feet of 3-inch hose for conveying water, and floating tanks for the same purpose will be provided. The circular wells in which telegraph cable is usually stowed will be used as reservoirs, and there are also 40 water tanks in the hold. Another ship, belonging to the Telegraph Construction and Maintenance Company, the *Kangaroo*, was chartered by the Admiralty on Wednesday, to be used for the storage of water. Her cable tanks will be utilised for holding 60,000 gallons of water.

Obituary.—The death is announced in New York of Mr. Luther Tillotson, well known and greatly respected in America in connection with telegraphy, and head of the firm of Tillotson & Co., merchants in railway, telegraph and electrical supplies.

The South of England Telephone Company, Limited.—This company has received from the Right Hon. the Postmaster-General the Post Office license for 27 years for the establishment and working of telephone exchanges in the district acquired by the company from the United Telephone Company, viz., the counties of Northampton, Norfolk, Bedford, Cambridge, Huntingdon, Buckingham, Oxford, Berks, Suffolk, Sussex, and that portion of the counties of Kent, Essex, Surrey and Hertford, as is not in the Metropolitan area of the United Telephone Company.

The Ball Machine.—Professor Silvanus Thompson evidently dislikes the subject of this machine, and states that its construction, at least from one point of view, is defective. At all events, the machine works as well as any with which we are acquainted, and we would ask if certain advantages possessed by this dynamo do not more than counter-balance the defect to which Mr. Thompson refers. With a given amount of wire spread over two armatures instead of one, the pole-pieces are brought proportionately closer to the iron rings of the armatures, and double the cooling surface is presented by the wire. Are not these advantages which, however slight, may fairly be taken as a set off against the absence of a second pole-piece, which the inventor himself would readily admit had no real meaning to him at the time it was first taken away, but which his results have shown there is actually no necessity for.

The Lalande-Chaperon Battery.—Mr. Stanley Currie has sent us the following particulars respecting this battery:—"I notice some of your correspondents are making inquiries with regard to the Lalande-Spence* oxide of copper primary battery. I have been using one of the batteries constantly for a considerable time for intermittent work, and for the last two months have been experimenting with a great number of cells of different forms and sizes for the Standard Electric Light Company, who hold the patents for England. The form of cell hitherto used has been the horizontal or tray form. The *working* E.M.F. of these cells is, as you have correctly stated, about ·6 volt. The company are now, however, adopting a vertical form of cell, which is for many reasons greatly superior. These cells have a slightly higher working E.M.F. of about ·7 volt. They are now being made in two sizes, one giving 10,000 ampère hours with a steady output of 30 ampères, and a smaller size giving 1,400 ampère hours at output of 10 ampères. A great feature of the battery is the fact of there being practically no action in open circuit. Thus the larger cells would maintain 30 ampères for 330 hours, and the smaller ones 10 ampères 140 hours. The work can be spread over a period of months if necessary. I have had a battery of the horizontal form of cell in constant use for intermittent work since August last. It was recharged once in December, and gives me 40 volts and 6 ampères as constantly as could be desired. In reply to your correspondent, Mr. Browne, I should recommend, as he requires so small a current, his using 17 of the horizontal form of cell, which give a steady output of 3 ampères.† These cells hold about 400 ampère hours, and thus, at the rate of 2·5 ampères, should run for 150 hours, which at five hours a-day would last 30 days. The internal resistance of the cells is very low, that of the large form being about ·005 ohm, and the small one ·02 ohm. The battery giving off no smell or noxious fumes is a great point in its favour. I often spend many hours a-day in a room where there are over 200 cells, and have suffered no inconvenience whatever. I shall be very glad to give any further particulars I can."

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* We believe Mr. Berger Spence has taken out patents in connection with this battery.

† Mr. Browne requires 4 ampères for his lamps.—EDS. ELEC. REV.

Explosion of Gas.—A very serious explosion of gas occurred soon after mid-day, on Friday of last week, at a newly built hotel in Gauden Road, Clapham, owned and tenanted by Mr. C. J. S. Shannmaw, hotelkeeper. William Mahoney looked for a leakage with a lighted candle, and was blown from one end of the room to the other, being fearfully burnt about the face and arms.

Universal Time.—Messrs. Kendal and Dent, who are offering a prize of 100 guineas for the best essay on "*Universal Time (New Style) and our future Watches and Clocks*," have published a valuable time chart showing the exact difference between Greenwich mean time and the local time at a large number of the principal towns throughout the world.

Town Lighting by Electricity.—After what has been wrttten concerning the town of Colchester our readers will feel a relief in perusing the description of the lighting of Temesvar. Naturally the conditions existing in the two places are totally distinct, as in the latter case the lighting appears to have been carried out chiefly through the high-handed action of the gas company, and the streets only are illuminated electrically. A similar installation, carried out by almost the same kind of plant, to which we can point in England, was that of Chesterfield, which, as our readers are aware, did not prove of long duration. The Temesvar street lighting, however, deserves more than a passing mention, and that is why we have so fully reproduced the article contained in our German contemporary.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Atlas Electric Appliances Company, Limited.—The second annual return of this company, made up to the 16th inst., was filed on the 23rd inst. The nominal capital is £2,000 in £1 shares; 707 shares have been taken up, and the full amount has been paid thereon. Since the last return 700 shares have been allotted. Registered office, 206, St. George's Street, E.

Electric Signal Company, Limited.—An agreement, dated 9th inst., was filed with the documents of this company on the 18th inst. This agreement states that shares in the company have been issued to the amount of £1,500, of which sum £500 has been issued in the name of Mr. James Enright, and the company has power to issue further capital to the extent of £1,000, and is desirous of obtaining powers to raise a further sum of £500 capital. Mr. Enright claims to be entitled to have allotted him one-third of the total capital from time to time issued, but consents to release the company from this claim for the sum of £50, which amount the company will pay in fully paid up shares.

Railway and Electric Appliances Company, Limited.—An order of the Chancery Division of the High Court of Justice, dated 17th December, and filed with the documents of this company on the 23rd inst., directs that certain contracts to take shares in the company be set aside, and that the registry of members of the company be forthwith rectified by striking out the names of the several plaintiffs therefrom. The order further directs the payment of several sums of money in discharge and settlement of certain claims against the company.

Laing Electric Light and Power Company, Limited.—The annual return of this company, made up to the 16th inst., was filed on the 23rd inst. The nominal capital is £1,000,000 in £10 shares; 12,007 shares have been taken up and are fully paid. As compared with the previous return, there is an increase of £50 in the paid up capital.

CITY NOTES, REPORTS, MEETINGS, &c.

India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

THE twenty-first ordinary general meeting of this company was held at the Cannon Street Hotel on Tuesday, Mr. George Henderson, chairman of the company, presiding. There was a fairly large attendance of shareholders. The directors' report appeared in the REVIEW of last week.

Mr. Tyler, the Secretary, having read the notice convening the meeting,

The Chairman said: Considering the many complaints one hears on all sides of reduced business and shrinking profits, I think we may be well satisfied with the account we are rendering of our progress last year, and thankful for it. The dividend we recommend is a good one, and if to some it seems that we might do more in that way, they may rest assured that the matter has been well considered by the board, and that we have good uses for the undivided profits we have put into the reserve and carried forward. In fact, we have felt the need for more capital for some time, and the decision to issue new shares in the terms of the allotment letters now in your hands not only provides more capital, but gives the shareholders a substantial bonus at the same time. More capital, I need hardly remind you, means less borrowing, and therefore less interest to pay, and an important saving by way of discount on our purchases. I need add nothing to the satisfactory statement in the report as to the sales of last year. We shall push our sales in all directions vigorously, but I hope prudently, both in the old grooves and the new ones open to us by our Act of Parliament. The fresh capital you are supplying will much facilitate our operations, and I expect will yield you a good return on your investment. We had several small cable contracts during last year; the Senegal cable was laid towards the close of the year. The 6 per cent. debentures of the Spanish National Submarine Telegraph Company, which we took in part payment of our cables, and which figure in the item of £130,737 in our balance sheet, seem to us to be a good investment. At a favourable opportunity we intend to issue them. I may explain that the Cape Verd Islands cable mentioned in the accounts, is a short line between St. Vincent and Santiago, laid under engagement with the Portuguese Government with the view of connecting those islands with Western Africa, a work which we hope to have more to say about on a future occasion. With respect to the premium on new shares, I may mention that we shall add this to the reserve fund. I move that the report and accounts now presented be received and adopted, and that a dividend of £1 per share, free of tax, payable on and after the 25th inst., be now declared.

Mr. S. W. Silver seconded the motion.

Mr. Dixey said this was the 21st ordinary general meeting of the company, so that it might be regarded as having attained its majority, and he thought the directors were entitled to hearty congratulation, for the company, owing to their able management, had reached a position of which they might well be proud, especially as the success of the past promised to be still greater in the future. The directors had marked this coming of age by a proposed addition of £104,000 to the capital; and if the capital had justified their expectations in the past—£312,000 yielding them 15 per cent.—he ventured to predict that with a capital of £416,000 it would exceed their expectations in the future, and give them a dividend of 20 per cent. Larger means implied larger possibilities, the creation of new business, expansion, wider development, and under their directors he was sure this meant an increase in profits and an increased dividend. The addition of £104,000 to the capital was made irrespective of that meeting, consequent upon powers conceded to the directors many years since; but he felt sure that it would be satisfactory to the directors to know that their course of action was thoroughly endorsed by the shareholders, and that whilst they gratefully appreciated their services in the past, they cherished the greatest confidence in their good management as to the future.

Mr. Lamont said the accounts put before the shareholders were no doubt of a most gratifying character, especially in comparison with those of many other companies, but it hardly appeared to him that the directors were pursuing the most economical course with regard to the raising of fresh capital. An addition of £100,000 to the capital, if they took their dividend at the same rate in future as now, signified a charge of £15,000 on the company in some form or other. They had £100,000 in mortgage debentures, and he did not perceive why they could not proceed further in that direction and effect a great saving to the company. If they raised mortgage debentures even on the same terms as before—and he presumed with the improved credit of the company they could be raised at 5 per cent. instead of 6 per cent.—but taking the latter there would be a saving to the company of £6,000 a year. There was another consideration—they might not always find their trade so good as it had been; there might be various changes such as they had seen in regard to many other manufactures, and they might not always want so great an amount of capital; it might prove burdensome to them with the increased competition, which grew more every day. He would like to know if the directors were thoroughly satisfied that this was the best course.

A Shareholder asked if the £130,737 was all in debenture stock, or in shares and debenture stock.

Mr. Kelso inquired as to the purposes to which it was proposed to put the reserve fund. Was it for equalising dividends?

Mr. Cochrane said he was aware that in the articles of association a certain percentage of depreciation was fixed, but he noticed that the property of the company was represented by £446.000, whereas the depreciation was only £14,000, or about 3 per cent. This appeared to him inadequate.

The Chairman said, in reply to Mr. Lamont, that there was a distinct understanding that no more debenture bonds were to be raised by the company while the others were running, and the directors thought the course suggested was the best and the cheapest. The £130,737 was partly in shares and partly in debentures, but mostly in debentures.

A Shareholder: The market value was the thing I wanted to be at.

The Chairman: We think we have kept well within the market value. We have not put them on the market yet, but they are well worth what they stand at. The reserve fund, he continued, was used in the general business of the company. By Article 94 the directors might, before recommending a dividend or bonus, set aside out of the profits of the company such sum as they might think proper as a reserve fund to meet any contingency, for equalising dividends, or for extension of works. Hitherto they had required it entirely for the general business. The depreciation was settled by the articles, but in the £446,000 were included the steamships, which stood at a very low value on the books, and which, therefore, had not been reduced at all this year.

The motion for the adoption of the report and accounts was then put to the meeting and carried unanimously.

Mr. Silver moved the re-election of Mr. Abraham Scott as a director, the Chairman seconded, and it was agreed to.

Mr. Treble moved, and Mr. Dixey seconded, the re-election of Mr. Weise as auditor, and this also was carried.

A vote of thanks was then accorded the directors upon the motion of Major Ramsay L'Amy, and the proceedings terminated.

Telegraph Construction and Maintenance Company, Limited.

THE report of the directors states that the accounts for the year show a net profit of £95,096 6s. 10d., after charging the interest on the debentures. To this sum must be added £66,710 1s. 9d. brought forward from last year, making a total of £161,806 8s. 7d. From this amount is deducted the interim dividend of 5 per cent., paid July 22nd, 1884, amounting to £22,410, leaving £139,396 8s. 7d. to be dealt with. Of this sum the directors propose to distribute a dividend of £1 16s. per share, absorbing £67,230, being at the rate of 15 per cent., and making, with the amount already paid, a total dividend for the year of £2 8s. per share, or 20 per cent., free of income-tax, leaving £72,166 8s. 7d. to be carried forward to the next account.

The operations carried out during the year 1884 have been as follows:—(*a.*) A cable, 875 miles in length, which was manufactured in 1883 for the Eastern Extension Telegraph Company to connect Saigon with Tonquin, in the China Sea, was laid in the month of February. (*b.*) The Brazilian Submarine Telegraph Company's duplicate lines between Madeira and St. Vincent, and between the latter island and Pernambuco, part of which were manufactured in 1883, amounting in all to 3,030 miles, were laid between the months of March and July, and three repairs were effected in that company's original cables during the same time. (*c.*) The Direct Spanish Company's duplicate cable between the Lizard and Bilbao, 473 miles in length, was laid during the month of May. (*d.*) A cable, 40 miles in length, has been laid across the Strait of Sunda (between Java and Sumatra) to replace the one destroyed by the volcanic eruption of 1883. Sundry lengths of cable, amounting to about 660 miles, have also been laid in the Australian and China Seas, to make good the existing lines of the Eastern Extension Telegraph Company, the portions thus renewed having been picked up. These services were carried out at various times between the months of February and August. (*e.*) Short lengths of cable have been manufactured during the year for several telegraph companies; the German Union Telegraph Company's cable between Hamburg and Heligoland has been repaired; and in the month of December the *Sunk* light vessel at the mouth of the Thames was connected by a cable with the Postal Telegraph Office at Walton-on-the-Naze, as an experiment, for the corporation of the Trinity House.

In view of the wear and tear of some of the company's ships, owing to constant work, the directors decided that the time had arrived to build a new vessel, of about 1,500 tons, builders' measurement. This vessel is being built by Messrs. Laird Bros., at Birkenhead, and will be fitted with all the improved appliances for laying and repairing cables.

She ss. *Seine* is also being supplied by the same firm with new engines and boilers, and is undergoing a thorough refit.

With this exception, the company's ships, and the factories at Wharf Road and East Greenwich, are in efficient working order.

Balance sheet, December 31st, 1884:—To capital, 37,350 shares at £12 each, £448,200; to debentures, £150,000; to debts, reserves and suspense accounts, £567,149 16s. 9d.; to reserved fund, £50,056 12s. 6d.; to profit and loss, £139,396 8s. 7d.; total, £1,354,802 17s. 10d. By property, £483,973 1s. 11d.; by debts owing to the company, £417,123 5s. 7d.; by cash in hand and on deposit, £98,336 6s. 3d.; by sundry securities, December 31st, 1884, £355,370 4s. 1d.; total, £1,354,802 17s. 10d.

Profit and loss for the year ending December 31st, 1884.—To directors' extra remuneration, £3,364; to balance, £95,096 6s. 10d.; total, £98,460 6s. 10d. By net profits, £100,384 14s. 4d.; less directors' minimum remuneration, £2,000—£98,384 14s. 4d.; by transfer fees, £75 12s. 6d.; total, £98,460 6s. 10d. To interim dividend, being interest on capital at 5 per cent., paid July 22nd, 1884, £22,410; to balance, £139,396 8s. 7d.; total, £161,806 8s. 7d. By balance, £95,096 6s. 10d.; by balance from last year's account, £66,710 1s. 9d.; total, £161,806 8s. 7d.

To dividend at 15 per cent, £67,230; to balance, £72,166 8s. 7d.; total, £139,396 8s. 7d. By balance, £139,396 8s. 7d.

The South-Eastern (Brush) Electric Light and Power Company, Limited.

THE following is in answer to communications respecting this company which have appeared in previous issues:—

68a, Cow Cross Street, London, E.C.,
21*st February*, 1885.

The directors have read with surprise and regret the report dated 9th inst., of the committee appointed at the general meeting on the 22nd December last, and the circular of the 14th inst., addressed to the shareholders by W. Hewett, Jun., and R. Braithwaite, as, after the conferences which have taken place, they strongly object to the proposal for the immediate liquidation of the company.

The directors had an interview with the committee on the 4th inst., at which it was proposed that a joint deputation of members of the board and of the committee should wait on the directors of the Anglo-American Brush Corporation, and the directors' letter of the 5th inst., set out in the report of the committee, refers most distinctly to this arrangement.

To the astonishment, however, of the directors, the committee have issued a report recommending the voluntary liquidation of the company forthwith, and that afterwards an attempt should be made to effect terms with the Anglo-American Brush Corporation. That is to say, first destroy the value of the property you possess and then try to sell it, as under the licenses from the Anglo-American Brush Corporation the act of going into liquidation cancels the concession. This mode of procedure, being so unbusiness-like, is not at all likely to be acceptable to the shareholders.

The figures summarised by the committee most imperfectly represent the approximate balance-sheet prepared by Messrs. Price, Waterhouse & Co., in order to show the position of the company on the 31st December last.

With regard to the Colchester installation, which was only completed in June last, and is invaluable as evidence of the success of the B.T.K. system, the directors have always contemplated either the transfer of the business to the corporation of the town, or to a local company to be formed for carrying on and extending it; and in case this could not be accomplished, they would seek to obtain permission from the Board of Trade to cancel the license and remove the plant to a locality where electric lighting would be more appreciated. To sell the plant for the "breaking up value" would entail a heavy and unnecessary loss.

The reference to the Consolidated Company would imply that the sum of £15,000, advanced jointly by this company and the Provincial Company, "is now wholly represented by patents acquired by that company, and by the plant and fittings of the factory in Cow Cross Street;" whereas the committee were distinctly informed that there was also a large and valuable stock of accumulators, finished and unfinished, and of electrical apparatus of various descriptions.

The directors pledge themselves to use their best endeavours to make terms with the Anglo-American (Brush) Corporation; to try to sell the Colchester installation as a going concern; or, with the consent of the Board of Trade, to remove the plant elsewhere; and then, at an early date, to wind up the company voluntarily.

The adjourned ordinary meeting to receive the report of the committee will be held here on Friday, the 27th instant, at 12 o'clock, noon, and if the company is to be saved from absolute wreckage, the shareholders must reject the recommendation of the committee.

The South of England Telephone Company, Limited.—This company announces an issue of 20,000 six per cent. first preference shares of £5 each (with one fully-paid ordinary share for each preference share). The preference shares now offered are entitled to a preferential and cumulative dividend of six per cent. per annum, and to preferential repayment in any final distribution of assets.

Western Union Telegraph Company, Limited.—Messrs. Morton, Rose & Co. notify the payment on March 2nd of the coupons and drawn bonds of the Western Union Telegraph Six per Cent. Sterling Loan.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th February, are £2,319, as compared with £3,031 in the corresponding period of 1884. The November receipts, estimated at £4,456, realised £4,514.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending February 20th were £2,760, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1885.

1878. "Connecting or securing the ends of telegraph wires." H. W. Brewtnall. Dated February 11.

1990. "Construction of electric arc lamps." A. Serraillier, F. Ducher. Dated February 14.

2081. "Manufacture of incandescent electric lamps." O. E. Woodhouse, F. L. Rawson, F. V. Hughes. Dated February 14.

2094. "Distributing electricity for lighting and other purposes." G. Forbes. Dated February 14.

2106. "Electric stop-motion applicable to stockinette and knitting machines." R. H. Lendrum. Dated February 16.

2117. "Electric telephony." J. G. Lorrain. Dated February 16.

2122. "Construction of dynamo-electric machines." H. Jones, Dated February 16.

2126. "Vessels or baths for galvanising, tinning, or coating iron or other metal." W. H. Luther. Dated February 16.

2135. "Construction of insulators for electric telegraph and telephone wires." W. C. Johnson, S. E. Phillips. Dated February 16. (*Complete.*)

2146. "Electrically operated valves for waste-not cisterns, &c. M. Syer. Dated February 17.

2162. "Electric light switch." A. P. Lundberg. Dated February 17.

2165. "Construction of electrical batteries." J. T. Armstrong. Dated February 17.

2168. "Electrotype plates." A. W. Marshall, American Press Association. Dated February 17.

2177. "Electric arc lamps." L. A. Groth. (Communicated by H. Pöge and E. Fischinger.) Dated February 17.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1884.

770. "Improvements in dynamo-electric machines, and in the method of constructing the armatures thereof." T. Parker and P. B. Elwell. Dated January 5. 6d. Fig. 1 of the accompanying drawings is a longitudinal section through a dynamo-electric machine, fig. 2 is a section taken on line, *x*, *x*, of fig. 1, and fig 3 is a half-plan thereof. A, A is the armature frame, and consists of a series of vanes or flat arms, *a*, *a*, &c., formed with or fixed to a central boss, B, which is itself formed with or fixed to the spindle, C. These vanes, *a*, *a*, have their outer edges straight and parallel with the spindle, as shown. In the armature illustrated it will be seen by fig. 1 that the whole length of armature frame is formed of two sets of vanes, with the vanes of one set butting respectively against those of the other set, so that the outer edges of the corresponding vanes of each set form continuous edges parallel with the spindle. The vanes are, however, electrically insulated between their butting edges as shown at a^1, a^1, fig. 1. An iron core is formed upon these vanes by winding iron wire around them as around a cylinder, or by slipping over the frame a series of sheet iron rings. An iron wire core is shown in section, fig. 1, and for a part of the distance only along the armature, for convenience of drawing. When the iron wire is wound on, as aforesaid, then, in order to prevent the flatness of the coils between the edges of the vanes which would arise from attempting to coil the wire upon the skeleton frame, and in order to give the coil a true cylindrical shape, blocks of wood (or other suitable material), having their surfaces turned up to complete the cylindrical surface, are inserted between the vanes, and held in position by discs of wood (or other suitable material) screwed to their ends.

FIG. 1.

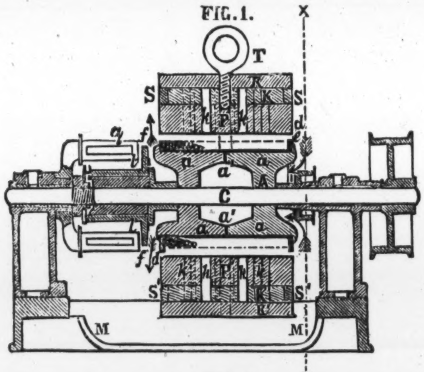


FIG. 2.

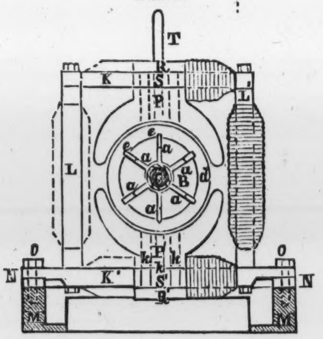
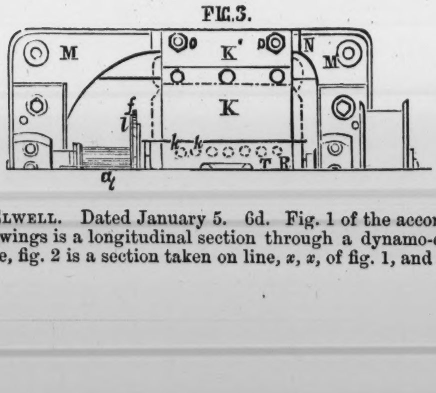


FIG. 3.



2494. "Improvements in galvanic batteries and in means for supplying the exciting liquid to and removing it from the same." P. R. de Faucheux d'Humy. Dated January 31. 6d. Relates principally to improvements upon a previous invention for which letters patent were granted to the inventor, dated October 27, 1882. No. 5108.

2858. "Improvements in means for producing and utilising electric currents in secondary circuits." L. Gaulard and J. D. Gibbs. Dated February 6. 6d. Consists of an induction apparatus constructed with a primary conductor forming part of an inducing electrical circuit, around which are laid insulated conductors, forming part of an induced circuit parallel to the primary or central conductor, and these several conductors of the induced circuit are connected at their terminals in multiple arc with a single wire forming part of an electric circuit for light or other purposes.

2975. "Improvements in electrical tell-tale alarm apparatus for indicating whether an insufficient or excessive amount of feed is being supplied to flour grinding mills, sifters, and other like machines." T. F. Hind and R. Lund. Dated February 8. 6d. Consists in providing the spout through which the material to be operated upon is conducted to the hopper with two collapsible or accordian jointed diaphragms, the collapsing or distending of the diaphragms being influenced by the amount of feed passing through the spout and so arranged as to cause an electric bell to be sounded whenever the feed is either insufficient or excessive.

3098. "Improvements in signalling by electricity." E. B. Bright. Dated February 11. 6d. In the employment of the electric fire alarms, for which the inventor obtained patents No. 596 and No. 3801 in 1878, it has occasionally happened that the person giving an alarm of fire by means of one of the street call posts has returned the handle back too soon, before attention was given and the locality of the particular post noted by means of the apparatus at the fire engine station to which the call was made. To provide against this contingency the inventor has devised the following improvements:—The length of resistance wire in the street post or call box is wound on an iron core and constitutes an electro-magnet which actuates a movable armature when the electric current flowing from the fire engine station is made to pass through the electro-magnet. This takes place when the alarm handle is pulled out, which separates two springs which had previously (while in contact with one another) kept the electro-magnet on short circuit. To this short circuiting arrangement is added a regulating stop (adjustable by a screw) against which the movable armature rests when no call is being given; but on an alarm call being given by pulling the handle, and the current thus diverted through the electro-magnet by the "short-circuiting" springs being separated, the armature is attracted to the electro-magnet from the stop. The armature is connected to the line wire in one direction (say the incoming) and also to one end of the electro-magnet. The other end of the electro-magnet is connected to one of the short circuiting springs, to which the line wire in the other direction (say the outgoing) is also joined. The other short circuiting spring is connected to the stop or stud against which the armature rests when no call is being given. Thus in each street call post or alarm box there are two points where the short circuit in connection with the electro-magnet is closed or opened—firstly between the springs moved by the alarm handle, and, secondly, between the armature of the electro-magnet, and the stop or stud against which it rests when no alarm is being given to the fire engine station. The effect of this arrangement is that when the alarm call is given by pulling the handle and separating the springs, the movement of the armature from its stop to the electro-magnet makes a second break in the short circuit; so that any premature replacement of the call handle alone does not again put the electro-magnet on short circuit, or interfere with the call signal and the locality of the post being indicated at the fire brigade station by the resistance wire of the electro-magnet in the street post. As soon as the flow of the current is temporarily interrupted at the fire engine station by the movement of a "make and break" key, the movable armature in the street post is released from the electro-magnet and returns to its stop. The movable armature is connected to a red disc which is moved before an aperture in the street post or call box upon the alarm being given, and which is only moved away again when the acknowledging signal is given on the temporary cutting off of the current by the "make and break" key at the fire engine station as previously described.

3282. "New means or apparatus for the mechanical generation of electricity, also applicable for electro-mechanical purposes." E. L. Voice. Dated February 14. 4d. Relates to machines consisting of one or any practicable number of electro-magnets, whose cores are made to be capable of rotating axially in fixed solenoids, or the solenoids may be rotated and the cores fixed. Each core is composed of transverse discs or flanges of soft iron, insulated from each other, but in electrical contact with and supported by a spindle passing through the centre of the said discs or flanges. At or near the outer periphery of the discs a number of conducting rods are fixed to the edge of each disc in a direction parallel to the length of the core. These conducting rods convey the current to the ends of the cores, where it is taken off by collectors, the other collectors being in electrical communication with the spindle.

3579. "Improvements in the process or method of casting plates for use as elements in secondary batteries, and in apparatus to be used therefor or in connection therewith." H. J. Haddan. (Communicated from abroad by C. F. Brush, of America.) Dated February 19. 1s. 8d. The object of the invention is to produce castings complete and sound, as near as may be, in all their parts, and free from holes and other defects.

3770. "A new electric couple for producing electricity." G. Przibram. Dated February 22. 6d. In an impermeable vessel two cells or vessels are placed concentrically one within the other, and made of clay or a material or materials having very small pores, in order to only allow a restrained permeability, and being little or not at all liable to corrosion by acids or alkalis. Thus two outer ring-shaped chambers and an inner or central cylindrical chamber are formed in the vessel. The outermost ring chamber contains an alkaline solution or lye of any desired density or concentration, and also the electrode or electrodes, by the immersion of which electricity is generated, preferably a plate of zinc conveniently bent to fit the chamber and carrying the negative terminal. The intermediate annular chamber is filled with water, which may be slightly acidulated, or a small quantity of alkaline solution (soda or potassa) may be added to the same; however, these additions are not indispensable. The central cylindrical chamber contains nitric acid, or any other compound which is rich in oxygen and easily parts with a part thereof, and the other electrode destined to gather the electricity generated; it is preferably made of carbon, and carries the positive terminal.

3795. "Improvements in telpherage." Fleming Jenkin. Dated February 22. 6d. Consists in the improvement of rod or road so as to adapt it better to the gripping wheels of the locomotive, and the simultaneous improvement of the gripping wheels so as to adapt them better to the road.

3796. "Improvements in trucks and locomotives for telpher lines." Fleming Jenkin. Dated February 22. 6d. Consists in so arranging the wheels, frame, and coupling-pins or eyes that a suspended truck or locomotive shall be fit to follow a telpher line when its direction is changing rapidly round curves or corners, and shall also be fit to run on steep inclines, these actions taking place with the least friction and the smallest risk of leaving the line, whether at the curves or on striking other trucks or trains.

3835. "Improvements in call or signal appliances for telephones and house telegraphs." G. W. von Nawrocki. (Communicated from abroad by A. J. W. Münch, of Berlin.) Dated February 23. 6d. By means of this invention the use of a battery is avoided for call or signal appliances for telephones and house telegraphs. This is accomplished by the induction current set up in the coils on the poles of the horseshoe magnet by the short and rapidly following closing and opening of the same. These currents are strong enough to put an alarum in motion.

3981. "Improvements in the construction of sensitive electric fuses and detonators, and in the explosive compound (priming material) employed therein." P. Ward. Dated February 26. 4d. The inventor employs (preferably) small inexpensive wire, known commercially as "bonnet wire" (about 26 B. W. G.), of iron, copper, or other conductor of electricity, suitably covered or insulated with cotton, silk, or other non-conductor of electricity. This wire is cut into lengths suitable for the purpose for which the fuse is to be employed. The lengths of wire are then bent in their middles (so as to form a small closed loop at the middle) to which is given several twists or turns, so as to twist the wire upon itself. The loop hereinbefore mentioned is then cut, or the top nipped off, so as to expose or bare the conducting wire to a necessary extent, and the unravelled insulating fibre may be cut or burnt off so as to leave a portion of the wire quite bare. The explosive compound (or priming material) laid over the cut loop is made by mixing together in a particular manner the following ingredients in about the following proportions, more or less, as may be found necessary for the various purposes for which the fuse may be employed, viz.:—Carbon, 2 lbs.; amorphous phosphorous, 1 lb.; chlorate of potash, 0·75; sulphur, 0·33; with the addition of alcohol, benzol, and bisulphide or chloride of carbon.

4548. "An improved appliance or band for generating electricity for therapeutic purposes." A. H. Byng. Dated March 7. 6d. The improved appliance is composed of two metallic bands placed on opposite sides of a piece or strip of flannel or other like suitable material. Each band is formed of plates of platinum and plates of zinc placed alternately and united together by soldering or otherwise. The plates are made with a number of holes or perforations, in order to allow the moisture or vapour given off by the body to pass through them to the flannel. The two bands are so placed relatively to each other on the respective sides of the flannel that the platinum plates of the one band come opposite the zinc plates of the other, and *vice versâ*. The two bands with the interposed flannel thus constitute a battery so soon as the flannel becomes damp from the vapour of the body, or is otherwise moistened. The two bands and flannel may be held together by means of India rubber bands, or in any other convenient manner. When applied to the body a thin piece of perforated or porous leather is placed at one side of the appliance, and a thin sheet of ebonite at the other.

4658. "Improved means for preventing galvanic action in iron and steel ships when protected by copper or other like sheathing, applicable also to other like submerged, or partially submerged, surfaces." B. L. Thomson. Dated March 10. 4d. The inventor applies to the iron or steel surface to be protected, a coating of vitreous material, to which surface he affixes the sheathing plates by means of India rubber solution, or otherwise. A layer of India rubber, or cork, felt, paper or canvas, or the like, saturated with India rubber solution, being interposed between the sheathing plates and the surface of the metal to be protected. When the sheathing plates are secured in position, he heats the vitreous covering surrounding the edges of the plates by means of a blow pipe, or otherwise, so as to cause the vitreous material to cover the joints, and thus produce a perfect junction which will prevent the entrance of water between the protecting plates and the surface to be protected.

CORRESPONDENCE.

Telephonic Circuits.

I suppose, Messrs. Editors, that you anticipate a reply to your comments on my letter in the Review of 14th inst., and I send you one (perhaps a verbose one), lest you should be disappointed. As you deny that my suit, which you are pleased, in your usual witty style, to term a "storm in a teapot," "was anything tangible," perhaps you will be kind enough to explain what you mean by that expression in regard to a suit, which has to your own knowledge had one hearing in Court, and which stands for trial upon its merits at as early a day as the rules of the Court will permit. Whether the whole or any part of your leader "was intended to be a personal attack on recent letters" written by me matters very little, as your readers are able to judge as to the correctness of my remarks on your leader of the 14th inst. It is possible that to your readers it may be very clear that there is a great apposition between your very lucid statement and the saying, "Bill and Sam are very much alike—especially Bill."

A correct paraphrase of that saying is "a 'closed' circuit and an 'open' circuit are very much alike, especially a 'closed' circuit," for did you not write, "by a closed circuit we certainly do not mean a circuit which is never under any conditions open at all, nor on the other hand does an open circuit mean one which is never closed."

I certainly did anticipate that you would reply to my comments on your leader of 14th inst., and that you would endeavour to justify the various extraordinary statements therein. I at the same time expected that you would at least be careful to correctly read what I had written, and to endeavour to understand it. You write:—

"If we are to accept our correspondent's arguments, both the Bell and Edison patents can be got over by the simple device of placing a key on every telephone instrument, which key by its depression will open both the primary and secondary circuits, and which the user is to depress for a moment during the time he is conversing through the apparatus."

I find you are placed in the dilemma—either you did not understand what I wrote, or you have wilfully misrepresented my statements. In none of my letters giving accounts of my experiments, which conclusively demonstrated that the undulatory current is not necessary for telephonic transmission of articulate speech, did I write that the current was to be open "for a *moment* during the time of conversing through the apparatus." In my first letter on this subject in the REVIEW of 3rd January I stated that to make the breaks in the current "I used a ribbon of paper having a line of small holes very close together running longitudinally through the centre," and that "the contacts through the holes in the paper allowed the current to pass in through the microphone at a speed of 1,000 words a minute." And in my letter in REVIEW of 14th February I stated that there were about 20,000 actual breaks of continuity of the current; and in my letter in REVIEW of 21st, the subject of your comments, I said that "if interruptions occur 6,000 times in a minute articulate speech cannot be heard."

How, then, can you reconcile the statement above quoted from your comments on that very letter with what I did write?

I quote the following lines from your comment:—"As regards the paragraph in the letter which says that 'it is somewhat of a new idea that the receiver has anything to do other than to be actuated by a current regulated and controlled by the transmitter,' we would point out that the primary and secondary circuits in an ordinary telephone apparatus are quite distinct circuits, and the interruptions which may take place in the primary circuit do not cause discontinuity in the secondary circuit, *i.e.*, the circuit in which the Bell instrument is placed."

These remarks are evidently intended to mystify my words, through substituting the word "circuit" for the word "current" used by me, and I assert that the interruptions which take place in the primary circuit or current, do cause discontinuity in the secondary current, and I call your attention to the fact that Bell nowhere in his patent names either a primary or secondary current.

I am really much pleased to find that on one point we do not differ, and that is upon the legality of using the special devices I employed in any country where Bell has a valid patent (as in the United States) for the use of an undulatory current for telephony. In my letter in the REVIEW of 21st inst. I say such an arrangement would not be considered an improvement but only a means to avoid Bell's claims, and I added that I "have devised a transmitter by which actual makes and breaks of the continuity of the circuit are produced by the air waves of the voice, and speech is produced with perfect articulation, and this not only *in spite* of, but by means of an arrangement specially devised to produce makes and breaks."

You are pleased to write "The major portion of the latter part of the letter we need not comment on as we have here mere assertions. We would add, has not our correspondent used the word 'current' in mistake for 'circuit' in one or two places in his letter?"

If by mere assertions you refer to the statement that a "closed" circuit in telephony is strictly a closed circuit, and that the word "undulatory" as used by Edison and Bell necessarily implies continuity, I must say that you refuse to accept Bell's and Edison's statements that the line circuit must always be closed. I now assure you that I have not used the word "current" in mistake for "circuit" in any one out of the seven times the word "current" occurs in my letter.

Having probably, in your opinion, given you further evidence of the egotism of your verbose correspondent, I conclude with a request that you do not mutilate this letter as you did that in the REVIEW of 21st inst., and I subscribe myself, as ever,

W. C. Barney.

February 23rd, 1885.

[The mutilation to which our correspondent refers was a postscript asking the meaning of "verbose." Surely personalities need not be carried further.—EDS. ELEC. REV.]

Edison's Patents.

Mr. Thos. J. Handford, in his letter in the REVIEW of 21st inst., ventures to say that the argument of "Das Telephon" in regard to Edison's patent, published in REVIEW of 7th inst., "is founded on a fallacy." Now I take occasion to differ from that opinion, and to say that I am really surprised at his gross ignorance of the Patent law as regards claims and disclaimers.

I have carefully examined Edison's patent, and I find that "Das Telephon" has correctly quoted from Edison's patent and disclaimers. It cannot be denied that Edison described in his patent, in the lines referred to by "Das Telephon," a *particular* instrument, being a combination of a resonant case diaphragm, and tension regulator. This particular instrument is referred to as fig. 10, and the 13th claim was for this particular instrument, and in the claims it is said to be "substantially as shown in fig. 10." I submit that when a patentee describes a particular apparatus, and makes that particular apparatus the subject of a special claim, and then subsequently disclaims it, there cannot be any question of the right of the public to use that device, notwithstanding the patentee has a claim for two out of three of the parts comprising the combination disclaimed.

This particular apparatus was brought to the notice of Mr. Justice Fry, in the action of U. T. Co. *v.* Cox-Walker, and Sir Frederick Bramwell, witness for the U. T. Co., in answer to a question by Mr. Justice Fry, replied:—"I may say the apparatus as an apparatus is disclaimed," and this answer was accepted by Mr. Justice Fry and by Mr. Webster, one of counsel for U. T. Co., as final on that apparatus.

According to the opinion of Mr. Handford, a disclaimer of a particular apparatus specially described in the patent and claimed, does not operate as a disclaimer so as to permit the free use of the apparatus by the public.

Mr. Handford's argument is not only not ingenious, but is glaringly fallacious. His argument is:—"My invention consists in putting the two parts together, but anything that you add to them in no wise affects my claim to the combination of these two parts, even although I disclaim or do not claim the addition. You may use fifty parts together, but if you use A and B in practically the same way as I do, and as I cover by my claim, you infringe my patent, inasmuch as the two parts which I claim are included in the fifty."

Now this argument cannot be applied to the use of the disclaimed apparatus of Edison. The apparatus as described by Edison is taken as it is; that is, a resonant case, diaphragm, and tension regulator; nothing is added to those three parts nor taken away from them. True, two of those parts are claimed as another apparatus different from the apparatus disclaimed; but that is no reason why the disclaimed apparatus is not free to the public.

If an apparatus specifically described and specifically disclaimed is not free to the public, I hope Mr. Handford will enlighten us as to what is the effect of a disclaimer.

W. C. Barney.

February 23rd, 1885.

Telephone Receivers.

Your correspondent "A. S. T. E." propounds the following question among others:—

"Is there any form of magneto transmitter incontestably free to the public?"

There are three such instruments *incontestably* free to the public, viz., 1st. The instrument described and exhibited in the specification of Bell's United States patent of 7th March, 1876, contained in the Official Gazette of the U. S. Patent Office of 7th March, 1876, and on view in the British Patent Office on 3rd July, 1876, more than five months prior to Morgan Brown's (Bell's) English patent.

The description of this instrument is as follows:—"An armature is fastened loosely by one extremity to the uncovered leg of an electro-magnet and its other extremity is attached to the centre of a stretched membrane." This instrument was used by Bell as transmitter and receiver. I here remark that this is the first publication in England of any of Bell's telephonic inventions.

2nd. The instrument described in the *English Mechanic* of 11th August, 1876, commonly called the goldbeaters' skin instrument. This has a piece of iron attached to the centre of a drumhead of membrane like goldbeaters' skin, used as transmitter and receiver.

This is the instrument used as a transmitter by Bell at the Philadelphia Exhibition in July 1876, in presence of Sir William Thomson, and was the subject of his report on awards, &c.

3rd. The famous "Glasgow" instrument generally called the "Glasgow" receiver. This has an iron disc fastened at one point of its circumference and tilted up over the end of the magnet. It being *called* a *receiver* does not prevent its being used in any manner and for any purpose, and it is more efficient as a transmitter than as a receiver.

This instrument was described in *Engineering* on 15th September, 1876.

These three magneto-transmitters are the only ones within my knowledge which are *incontestably* free to the public. I say *incontestably free*, because they are the only ones which the United Telephone Company admit not to be covered by what they call their *master* patents; at the same time I must remind your readers that the United Telephone Company threaten to prosecute any person who uses *any form of magneto* receiver, although the above-referred to instruments are free to the public to be used in any way or for any purpose whatever, and, in fact, these three instruments were used by Bell as receivers.

You Tea Koe.

February 23*rd*.

The Thomson-Houston Electro-motor.

I find that in your issue of January 24th, 1885, a brief notice, the matter of which is based upon an article in the New York *Electrical World* is given. It is entitled "The Thomson-Houston Electro-motor," and describes the skeleton model of the Thomson dynamo exhibited at the exhibition at Philadelphia. It was *never* for a moment *contemplated* to use the device as an electro-motor, nor would it, as constructed, be worth anything as such. The *sole purpose* for which I designed it was to show to the public the plan of winding used in the Thomson dynamo for arc lighting, and particularly the partial enclosure of the circular armature coils by the circular field coils, as well as the simple three-branch winding of the armature itself. Of course the mistake is not yours, but is only one of the many misstatements made by the writer in his article from which your extracts were made. I send you, enclosed herewith, a copy of the article in question, with marginal notes, pointing out a few of its numerous errors.

These errors might be excusable in a writer who had not so expressly stated, in several places in the notice, his intention of dealing with the apparatus from a "scientific" point of view.

Elihu Thomson.

Lynn, Mass, *February* 6*th*, 1885.

The Electric Light at Colchester.

Allow me to offer a few remarks upon the leading article in your issue of 21st inst.

The subject should be considered from two aspects, viz., the *scientific* and the *commercial;* the former being the most important to those interested in developing the electric lighting industry; the latter being governed by local and exceptional circumstances.

With reference to the scientific aspect of the question, I claim that the installation at Colchester has proved the success of the B.T.K. system.

This system consists of the generating of the electricity at a central station and its distribution through five storage stations, placed at convenient distances apart, so as to economise the cost of conductors. A high tension current is employed for charging the secondary batteries in series, and rocking switches are employed in connection with the master cells of the batteries. The cells are equally divided into charge and supply sections; they are automatically switched into charge or supply, alternately.

The batteries are coupled up in stacks of 30 cells, giving an average E.M.F. of 60 volts; the E.M.F. of the lamps employed being 58 to 60 volts.

The above constitutes the B.T.K. system, and the experience gained during the eight months it has worked satisfies us of its thoroughly practical character.

We have had to contend with difficulties in detail which may have been expected in working out so novel a system for the first time; but our troubles have not been due to the system, but to details of manufacture; the weak places in which experience alone could develop. Thus we have had to change the boxes originally employed for the secondary batteries, and have also had difficulties with the dynamo machines, which gave a current not absolutely constant, and therefore not quite suitable for charging the batteries. The first set of batteries was installed in January, 1884, but were only used as regulators to prevent the excessive breakage of lamps resulting from the direct running from the old "Brush" shunt-wound machines. On the 11th June, 1884, the whole of the batteries were in place, connected with the rocking switches, &c., and the B.T.K. system inaugurated.

From that time to the present the supply of electricity has been constant.

Within a few weeks of the completion of the system it was found that the boxes of the secondary batteries installed in January began to leak; they were constructed of wood, lined with inner cases of cardboard, with an intervening lining of paraffin wax; after six or seven months work the paraffin wax became disintegrated, and caused leakage. This necessitated an entire change of boxes, earthenware cells being adopted. These were ordered from two manufacturers, and unfortunately those supplied by one of the firms proved after a few weeks working to be unsound, involving a partial second change of boxes. The work of changing boxes, with the necessary alterations in supporting bars and connections—*without stopping the lighting*—was one of great difficulty and delicacy; but it was accomplished with only an occasional loss of pressure, owing to the impossibility of always fully charging the battery, through want of time. This caused the lights from some of the cells during change of boxes to give a dull light after running for a certain time, but with this exception no inconvenience was experienced; and since the change of boxes has been effected, the lamps have always run well at the candle-power of 20-C.P. alleged by the makers, viz., "Lane-Fox," "Victoria," "Swan," and "Consolidated."

The working at Colchester has been examined from time to time by English and foreign experts, who have expressed their approval of the system; and it has been adopted for the house-to-house lighting of the city of Lisbon.

As to the Act of 1882 being pleaded as an excuse for what has transpired at Colchester, you are mistaken in supposing that this company ever pretended anything of the kind. The work at Colchester is carried on under a license, and no questions have arisen with reference to the Act. I have urged, with others, that the Act requires amendment, especially with reference to the purchasing clause, which affects Provisional Orders; and while referring to the Act, there is another matter which has not received attention, viz., the power given to local authorities to take Provisional Orders in preference to other applicants, without compelling them to carry out the work.

The commercial aspect of the Colchester lighting is not yet satisfactory, but I do not think it deserves the epithets of "collapse" and "utter failure" used by you and quoted with so much apparent satisfaction by the *Journal of Gas Lighting*. In comparison with the commercial results obtained by other companies in initiating new electric lighting enterprises, the Colchester working is very far from being disastrous.

You attack the management of the company by assuming that no care was taken in making estimates before the enterprise was embarked in; but this is a gratuitous assumption altogether. Leading residents and the local authorities were consulted in the first instance, and afterwards a house-to-house canvas made of the district proposed to be lighted; the number of gas burners in each house was ascertained and of rooms not lighted with gas, and the information obtained decided the directors upon putting down the installation. The estimates of revenue were based upon obtaining about half the possible lighting in the district, viz., 2,200 lamps, burning 1,200 hours per annum, and ½d. per lamp per hour was fixed as the price consumers were prepared to pay. Gas being then at 4s. per 1,000, but subsequently reduced to 3s. 9d. Our experience proves that for the lighting already obtained 1,200 hours was an excessive estimate, although exceeded in one case, where the lighting reached 1,331 hours, but with shop lighting the average is very much lower.

The estimated cost of the plant and working expenses have not been exceeded, but in the anticipated revenue we are at present disappointed.

The plant under the B.T.K. system was not ready until the 11th June, 1884, and being in the middle of summer, many people who had made contracts with the company deferred going to the expense of fittings, lamps, &c., until the autumn; meanwhile the action of the shareholders in this and other electric light companies raised a doubt in the public mind as to their stability, and when the words "*and reduced*" were added to the title of this company it was misunderstood at Colchester, and many held off from changing their lighting arrangements, fearing that they might be spending money in electric light fittings in vain. The occasional dulness of the light during change of boxes to which I have referred also influenced some, interested parties taking care to make the most of it, although in gas supply deficient light from varying pressure and bad illuminating quality is not unusual.

There has been no want of energy in handling the matter; I admit that I am "enthusiastic," and without that quality I doubt if anyone is fitted to assist in pioneering the new industry. It is also useful not to be too thin skinned, otherwise the carping criticism prompted by professional jealousy and the "damning with faint praise" of *soi disant* friends would materially interfere with the perseverance necessary for overcoming the difficulties of such a business.

George Offor, *Manager.*

The South-Eastern (" Brush") Electric Light and Power Company, Limited.

68*a*, Cow Cross Street, London, E.C.,
23*rd February*, 1885.

Mr. Raymond and the Uni-pole-piece Dynamo.

In your issue of February 14th you reproduce from a paper by Mr. C. W. Raymond some rather excited remarks upon a few comments of mine on the Ball dynamo, made at the Philadelphia Conference.

In those comments I made the following points:—

1. That the Ball machine, though it has one pole-piece to each armature, has really two poles.
2. That in the absence of a second pole-piece the magnetic lines of force (which, in a well designed machine, would pass direct from the armature to the pole-piece) leak out into the surrounding air.
3. That in spite of this obvious and unmeaning omission the uni-pole-piece dynamo may (and does) work.
4. That it is in dynamos a defect for the lines of magnetic force to leak out of the magnetic circuit into the air.
5. That I saw upon the Ball uni-pole-piece dynamo at Philadelphia a placard warning visitors not to approach the machine for fear of magnetising their watches.
6. That on that occasion I did not notice any other dynamo similarly placarded.

Those are the points I made, and not one of them is denied by Mr. Raymond; instead of addressing himself to the scientific facts, he indulges in a personal attack, conspicuous by its want of good taste. It was not I who called the Ball dynamo a one-horse affair, however appropriate that inelegant term may be to the uni-pole-piece machine. Therefore, I most respectfully decline to enter into a personal altercation with Mr. Raymond on a matter which ought to be discussed on scientific merits.

S. P. Thompson.

Bristol, *February* 23rd, 1885.

Negatives or Positives.

I am glad to see that Professor Forbes, in his admirable lecture at the Society of Arts upon the "Distribution of Electricity," published in your last issue, has alluded to a detail in connection with secondary batteries, minute indeed in itself in comparison with the general subject, but of sufficient importance to have attention directed to it in order to correct if possible the so frequent mis-nomenclature of the elements.

It is absurd and confusing to hear the terms "negative" and "positive" indiscriminately and so often erroneously applied, the negative element or per-oxide plate attached to the positive pole being more frequently than not called the "positive," and *vice versa*. In fact, it has sometimes seemed so hopeless to dissociate, in the majority of minds, the denomination of the *plate or element* from that of the *pole* to which it is attached that, in order to avoid misunderstanding (outside pure electrical parlance), many have fallen into the habit of accepting the misnomer in an easy going way rather than take the trouble to explain and put the matter right.

Hoping to put an end to this confusion, I have latterly used the terms "positive-pole plates" and "negative-pole plates" when specifying respectively the per-oxide plates attached to the positive pole and the metallic plates attached to the negative pole; and, although I will confess to this not being a scientific way of dealing with the matter, yet I have found that misconceptions have without doubt been thus frequently avoided.

X.

February 24th, 1885.

Articulate Speech with a Make-and-Break Circuit.

In a letter dated New York, 14th inst., received by me to-day, I am informed that the experiments described in my letter published in the REVIEW of 3rd January last, have been repeated there with perfect success.

My correspondent writes:—"It seems now to be demonstrated that articulate speech can be had by a make-and-break current. Professors Brackett and Young, of Princeton, in connection with McDonough, have made a very interesting experiment. They took the indentations from the phonograph, and cut corresponding ones in the rim of a wheel about 33 inches in diameter, and from these indentations produced perfectly articulate speech."

It appears that these experimenters have substituted for the perforated paper used by me in my experiments, indentations in a wheel. The same letter informs me that the Bell Company, after a long-contested legal fight for a preliminary injunction against the Molecular Telephone Company before Judge Wallace, withdrew the motion.

W. C. Barney.

February 25th.

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